THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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ELECTRIC POWER POLITICS IN LONDON.

To those who are not deep students of electrical economics, it may appear that the numerous applications to Parliament for authority to undertake bulk supply in the metropolitan area merely represent the logical sequel of the grant of similar powers to provincial companies. For sufficient reasons, however, which may be disclosed later, any attempt to link the present situation with the exhausting campaigns of past sessions serves rather to complicate than to simplify the issue. What are now known as the Electric Power Companies, whose territory takes in practically every industrial community in the provinces, obtained their authority very largely on the consideration that, while the chief cities had some sort of supply already, there were many deserving urban and rural districts which did not afford a suitable site for the independent generation of electricity, and were in a state of electrical starvation, so to speak, that could only be remedied by their inclusion in a comprehensive scheme of distribution, the development of which would render such districts eligible for industrial settlement.

When we come to consider the territory commonly called Greater London, the same line of argument is scarcely forcible, and it becomes clear that "bulk supply" for the metropolis signifies not the transformation of a desert into a fruitful plain, but the more productive cultivation of an already fertile soil. "Bulk supply" for London means, in fact, consolidation or combination for the purpose of effecting economies which will filter down to the consumer ultimately, but which, in the first instance, properly handled, will make electric supply more profitable to the middleman.

So far as pure engineering is concerned with the question, discussion turns on the following points—first, whether the massing of steam plant, at two or three enormous stations, would result in any material reduction in the cost of production of energy, as compared with the conditions at present obtaining; and secondly, whether it is necessary or advisable to construct entirely new stations or whether some of the existing plants can easily be extended for the purpose. The latter is the point of variance between the new companies and the old. The Metropolitan or the City of London, or the North Metropolitan, say, in effect, "consolidate and concentrate by all means. Willesden or Bankside, or Brimsdown (as the case may be) is an admirable station from which to begin the wholesale supply for London."

Here we reach the border line of what we may term the political aspect. Capital has been subscribed or borrowed for numerous undertakings, not merely on the strength of their undisturbed possession of certain areas, but with a prophetic expectation that any reshuffling of those arrangements

brought about by technical progress, will yield an unearned increment convertible into gold. We can imagine this crowd of undertakers, with Islington and one or two others discreetly forming the tail of the deputation, protesting that they have done their duty to the consumer and to the Board of Trade, and that it is unjust for millionaire interlopers to start business at this stage after—as the chairman of the Westminster Co. said the other day, when declaring a 15 per cent. dividend—they have borne the heat and burden of the day.

The specious plea of the new-comers that they only propose to supply wholesale to existing authorities, or to undertakings, such as railways and canals, which cannot now obtain electricity on suitable terms, does not altogether dispose of the objections of the old companies, whose contention is that they prefer to do all these things for themselves, and that bulk supply is their just heritage; it is, in fact, the economic hinterland of their present business, and they are prepared to exploit it. Here the municipal undertakers cannot accompany them, for neither the L.C.C. nor the borough councils appear prepared to carry out wholesale generation and distribution, or to do anything but defend their own territories, which is not always a successful policy in the Parliamentary Committee Room. They will probably be politely shown out with some form of "protective clauses" which will prevent direct competition in their areas without their consent, not to be "unreasonably withheld." As for the new companies and the old, does not the conflict turn merely on the question whether Greater London should be partitioned, or whether it should be enfolded within the powers of one authority, perhaps with Government purchase provided for in the future? And may not this question itself be decided purely with regard to the proposed price of supply?

The Committee may pass through four stages in its inquiry — first, the engineering stage; secondly, the political; thirdly, the geographical; and fourthly, the arithmetical stage. Finding that wholesale distribution is expedient and feasible, the price offered by responsible promoters should have a decisive effect on the Committee, and rival promoters must be prepared finally for a sort of Dutch auction, if they succeed in eluding the preliminary difficulties of their hazardous course.

MUNICIPALITIES AND THE TELEPHONE SETTLEMENT.

The agreement between the Postmaster-General and the National Telephone Co., which we referred to at length last week, whilst of much interest generally, is of direct importance to those municipalities who have taken advantage of the permission given by the Act of 1899, to establish competing exchanges of their own, and it may be presumed that they will take the opportunity to review their positions and determine upon their future policies.

The principal importance lies, not in any of the details of the agreement, but in the fact that the Post Office acquires the National Co.'s exchanges in 1911. It has been suggested that the Post Office will be able to help the National Co. with underground facilities which the municipalities may prefer to withhold. We believe this to be a misapprehension, and that the local authorities may safely form their plans on the assumption that the Post Office will maintain a position of strict neutrality between the competing licensees. But the competition between the licensees will cease in 1911, and if any competition exists later it will be between a municipal licensee and the Post Office licensor. The policy of the Postal Department should be, and probably will be, to unify the services as soon as possible. The principle of goodwill for surrendered licence has been recognised in the National agreement, and if any surrender were made by municipalities it should also be extended to them. But the valuation of the goodwill is somewhat carefully guarded, and the profit upon which a municipal goodwill could be calculated does not yet exist. The municipalities have now had some experience of telephone working, and in making estimates of the possible valuations, they would be likely to see that greater care was exercised than, for instance, in the estimates upon which their enterprises were started. Any advantage from such a source seems to be extremely doubtful. The essential factors are the value of the plant upon its surrender to the licensor and the period when the highest value may be obtained. There is no doubt that the longer the surrender after 1911 the less will be the value of the plant, and that as a commercial proposition it will pay the municipalities to surrender their plant in 1911 and not continue the working of the licence later.

The terms upon which the Postmaster-General will take over the plants are practically the same for the municipalities and the company. He will take such plant as is in use, and as is suitable for his actual requirements at that date, and he will pay its fair market value at the time of its purchase, due regard being had to the nature and then condition of such plant, and to its state of repair. In competitive areas, the Postmaster-General may be expected to lay great stress on the provisions in his favour when valuing the plant, because in such areas there will be the inevitable expense of combining plants which have been designed not for co-operation, but for competition. Most liberal depreciation will be necessary if the book value of the plant is to be obtained at the date of transfer. And, in addition to the general depreciation, a special fund should be set aside for the plant which the Postmaster-General may find to be unsuited to his requirements.

Depreciation, unfortunately, is not a strong feature of municipal telephone enterprises at present, and it is not easy to see how provision is to be made in the future. The municipalities are, in fact, on the horns of a dilemma. To provide adequate depreciation would need an increase in the subscription rates, and an increase in the subscription rates would remove altogether the *raison d'être* of the competitive service. Under any circumstances, there is no possibility of a municipality receiving, on the terms of purchase defined in the licence, the amount of its investment, and in certain cases there is every probability of a large deficit. The question which then naturally arises is, will this deficit be likely to become greater or less by continuing the competition? We need hardly say that, in our view, the longer the competition lasts, the greater will the deficit become; and though there are, necessarily, difficulties to be overcome in arranging a cessation of the respective competitions, there is no doubt that measures should be taken to that end. To express the matter in a commercial form, the policy of the

municipalities should be to make the loss as little as possible, and cut that loss as soon as possible. To consider the matter from this commercial standpoint may be the more easy for the municipalities when they realise how little chance there is for them to achieve by competition any of those beneficent results which were expected.

The Commercial Engineer, or the Engineer "Commercial."

A paper was recently read by Mr. C. A. S. Howlett, before the Western Society of Engineers, on "The Commercial Aspect of Engineering." In the course of this paper the author compared the contracting or sales engineer to the motive power of a machine, and in the securing of contracts he placed salesmanship ability higher than engineering ability. There are, he said, certain traits of human character which do more to mould the opinion of a purchaser than any amount of technical knowledge of the intricacies of the apparatus. Tact is of paramount importance in the equipment of the sales engineer, and without this a man is liable to be very unsuccessful in the securing of orders. The academically trained engineer may be a particularly able technician and capable of grappling with almost any engineering problem thrown in his way, but, as a rule, his technical knowledge is not in itself sufficient to enable him to deal with prospective customers with a view to obtaining an order. A scientific training may, in fact, unfit a man for the commercial side of his calling.

In introducing the speaker, the Chairman remarked that "an engineer is a man who can do with one dollar what any fool can do with two; but then along comes the commercial man who takes 95 cents away from the dollar thus saved." The intention of the speaker apparently was to show that no matter what economies the engineer might make, it did not necessarily mean increased profits, as the commercial man came in and cut the price down.

Prof. Morgan Brooks, however, took a somewhat different view to this, and said that while the engineer might be a man who could do with one dollar what any fool could do with two, the commercial man was one who could sell for two dollars, what any fool could sell for one. He went on to advocate the development of the commercial instinct of engineering students, and following out a suggestion made by the author of the paper, that technical schools should incorporate in the course for senior students a series of lectures on salesmanship, he pointed out that they were actually doing this in the University of Illinois. He had prepared for his students from time to time specifications of various pieces of construction work, and had then got the students to estimate and submit bids for the work. All kinds of practical work of this nature is given to them, which involves their sending to various companies for catalogues and prices, studying up the selling points of the various makes of apparatus, and then preparing an estimate on the most ecomonical lines. After this they are induced to practice on their class mates as salesmen, "talking up" their various schemes with a view to inducing them to place the order with them. The plan, it is said, has so far been productive of much good.

We have heard of an American company training up their travellers in much the same way. The men have to go through the works, familiarise themselves with every detail of the apparatus which they are engaged to sell, and when they consider themselves proficient, have to appear before the Board of Management and "talk up" the apparatus to them. Every conceivable objection is advanced by the members of the management committee against the sellers' arguments, and if there is any one point in which he is beaten, or in which he cannot satisfactorily demonstrate to the Committee the superiority of his wares, he is sent back for a further period of probation.

But talking is not everything that is required in dealing with electrical engineering contracts. It is not of the least use for the old-fashioned kind of commercial traveller, who could talk and talk until doomsday upon anything, to call upon an engineer in reference to any proposed contract. It is essential that he should be an engineer, and be able to discuss the thing from an engineering standpoint. Nothing is more annoying to a busy man than to discuss matters for some considerable time with a traveller, and then, when any point of detail arises, to hear the latter excuse himself with the remark, "Oh! I shall have to ask one of our engineers about that, as I do not profess to be able to deal with technical points."

There is a real need for a man with an engineering training, combined with commercial ability, and all the qualities of the best type of commercial traveller. But the fear of being looked upon as "a traveller" often stands in the way of really capable engineers taking up the commercial side of the business. We know of cases in which engineers have given up lucrative positions because their work had drifted more and more into a commercial groove, and they have been content to work for less than half the salary in a purely engineering occupation.

Such a man would regard a traveller, or "tout," as he would call him, with the utmost contempt. "Bah!" he would say, "I would not have that man's berth for a million a year."

It is, in a way, the pride or prejudice of class, and whilst, in some respects, like the class prejudice between the tradesman and the "professional gentleman," it has the redeeming feature of being the result of a man's love for, and pride in, his calling, rather than to a feeling of social superiority consequent upon the accident of his birth.

And, just as the social class barrier between profession and trade is being trampled down, so will this engineers' prejudice against, and contempt for, the commercial man, be gradually eliminated.

Until this feeling has died out, however, a man who has adopted engineering as a profession, and made his friends among engineers, must, if for the sake of lucre he takes up the commercial side, that is the salesman's, be prepared to sacrifice his old friends and be ranked, in their estimation, as a "tout."

On the other hand, the ranks of the "commercial," or, to be more up-to-date, "the travelling representative," are being daily augmented by public school and 'Varsity men, and it is no uncommon thing to receive a traveller's card, bearing after the name the initials "M.A.," "B.A.," "B.Sc.," and the like. It is a significant sign of the times. There is money in it, and in these strenuous days the art of "getting on" is regarded as synonymous with the art of "getting money."

And the fact remains that, owing to the rate at which our technical schools are turning out electrical engineers, the supply of them is so much greater than the demand, that a man of good address and average ability who can obtain orders for a machine can make on the average at least double the income of the trained engineer who designs it, and who has gone through a long, laborious, and often costly technical training and engineering apprenticeship.

Electrical Standards.

It will be remembered that when the Engineering Standards Committee issued its interim report on generators, motors, and transformers, certain questions relating to the maximum temperatures permissible for insulating materials were left unsettled, pending the completion of experiments in progress at the National Physical Laboratory. The points under investigation included the maximum final temperature allowable, the permissible rise, and the relation between the actual maximum temperature of a coil at its hottest part, and the mean temperature as measured externally. The experiments have been rendered possible by financial aid received from the Government, and their results have been embodied in a report which may be obtained from the committee at 28, Victoria Street, S.W.

We understand that the report is to form the basis of a paper to be read before the Institution of Electrical Engineers by Mr. E. H. Rayner, who carried out the work under Dr. Glazebrook's direction. A preface to the report has been written by Sir W. H. Preece, chairman of the Electrical Plant Committee.

THE LOCALISATION OF FAULTS ON CABLES.

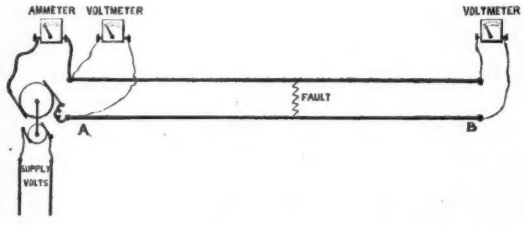
[CONTRIBUTED.]

When trouble occurs on a network of mains supplying light and power, it nearly always begins with an "earth." In fact, where single cables with metallic sheaths are used, it is impossible to get a "short" without an "earth," unless it occur in a mains box of some description. There are many methods of localising a fault on a given length of cable, but for accuracy and simplicity of application, the writer has never seen anything to compare with that which he endeavours to bring to notice in this article.

As the test is applicable to concentric, cored, or single cable, for either "shorts" or "earths," it may be said to cover all that is required for most systems of supply. The only case where the method does not seem to apply is where an "earth" occurs on ordinary rubber, or other insulated cable without metal sheathing of any description. The test is really a method of comparing the resistance of the defective cable from each end to the fault, and then calculating the distance from each end in the same proportion.

The only apparatus required is a small dynamo capable of giving, say, 50 amps. at from 1 to 10 or 20 volts, coupled to a motor wound to suit the supply pressure. A combined set of this kind is often used for charging individual cells in a battery.

Let us assume that an "earth" has developed on the outer conductor of a length of triple concentric lead-covered cable, forming part of a distributing system. After disconnecting the faulty length from the disconnecting box at each end, couple the small generator to the two conductors between which the fault exists—in this case to the outer and the lead sheathing—and put an ammeter in the circuit. Connect the motor to two live terminals in the disconnecting box, and run the set up till a convenient current is being put through the fault from the generator, then measure the volts between the lead sheathing and the outer of the cable. (A cell-testing voltmeter is usually all that is required.) At the same time have the pressure measured at the other end of the cable between the same conductor and the lead. This latter pressure, it will be seen, is equal to the drop in volts across the fault, and may of course be very little if the fault is of low resistance. The resistance of the fault is one of



the things we have to find, and we can now arrive at it by dividing the number of volts obtained at the far end of the cable by the number of amperes passing at the time.

Let C = the current passed through the fault from the end A; let E = the volts at A, and e = the volts at B; then the resistance of the fault $= \frac{e}{C}$.

The resistance of the cable from A to the fault $= \frac{E}{C} - \frac{e}{C}$.

Now, apply the test to the other end and substitute for E, C and e, E_1, C_1 and e_1. The resistance of the cable from the end B to the fault $= \frac{E_1}{C_1} - \frac{e_1}{C_1}$.

The distance of the fault from A and from B is as—

$$\frac{E}{C} - \frac{e}{C} \text{ is to } \frac{E_1}{C_1} - \frac{e_1}{C_1}.$$

If there are a number of service or other boxes on the length of cable under test, they may interfere with the accuracy of the results, but if the lead is properly bonded, as it undoubtedly should be, no trouble will be experienced. As a matter of fact, when a number of services are connected to the defective cable they may be made use of as an additional check on the calculation. By measuring the pressure between the outer connection in any consumer's fuse box and the lead of the service cable, while the testing current is being put through the fault, the distance of the fault from the service cable may readily be calculated. Several independent sets of figures may in this way be obtained, and the mean of the results taken as the point at which to open ground. Where a fault has occurred between the conductors of a concentric or 3-conc. cable without breaking down to "earth," the test may be made in precisely the same way, only connecting the generator to the defective conductors and measuring the pressure between them instead of between the lead and conductor.

The writer has met with success on every occasion on which he has applied this method of localising a fault. The time occupied in making the test and indicating the position of the fault is not more than 4 or 5 hours as a rule, and this success has been obtained on conc. feeders, multi-core pilot cables and 3-conc. distributors. In all instances the trouble has been found somewhere in the length of the hole that it has been found necessary to open in order to get at the cable. That is to say, within a yard of the exact spot indicated by the test, and this in lengths of 100 yards or more. Only in one case has this method of locating trouble proved erroneous, and that was due to difficulty in obtaining an accurate reading with the voltmeter in use. A second test on the same cable gave what proved to be the correct spot.

The fault referred to above was on a 9-core pilot cable, four wires of which had gone to "earth." Not having a suitable motor-generator with which to make the test, the writer was obliged to use a battery booster at the works, and by coupling this to two of the sound wires of the pilot he was able to get a low-pressure supply at the far end of the pilot wire. All the four "earthed" wires were coupled to one of the two connected to the booster, and the lead of the pilot was connected to the other. The booster was afterwards coupled to the lead of the pilot and the four "earthed" wires at the works end.

The results of this test were as follows:—

Testing from Works end of Pilot.—With a current of 15 amps., there was a pressure of 13 volts between the ends of the "earthed" wires and the lead or "earth." This $= \frac{13}{15} = \cdot866$ ohm. At the far end a pressure of ·8 volt was obtained. Thus the resistance of the fault $= \frac{\cdot8}{15} = \cdot052$ ohm.

On applying the test to the end remote from the works, the figures were: C = 8·5, E = 1·3, while at the works the pressure between "earthed" wires and "earth" was ·8 volt. It will be noticed that the tests showed a difference in the resistance of the fault. In the first test $\frac{\cdot8}{15} = \cdot052$ ohm. In the second test $\frac{\cdot8}{8\cdot5} = \cdot094$ ohm. Taking the mean (·073) and deducting it from the total resistance from either end, we have ·866 − ·073 = ·793 from works to fault, and $\frac{1\cdot3}{8\cdot5} - \cdot073 = \cdot153 - \cdot073 = \cdot08$ ohm from the other end.

The total length of the pilot wire under test was 1,000 ft. Therefore, the distance of the fault from the end remote from works $= \frac{1.000 \times \cdot08}{\cdot793} = 100$ ft., which, as has been said, proved correct.

To take another case: A length of 95 yards of 3-conc. distributor developed an "earth" on the outer conductor. On applying the test to the end A, C = 20·5 amps., E = 2·5 volts, while pressure (e) at end, B, taken at the same time = 0·31 volt. Making the test from B, C = 25 amps., E = 0·55 volt, while e at end A = 0·4 volt. The resistance of the fault as measured, showed practically the same result, and was taken as $\frac{\cdot4}{25} = \cdot0153$ ohm.

Resistance from A to fault $= \frac{2\cdot5}{20\cdot5} - \cdot0153 = \cdot1057$ ohm.

Resistance from B to fault $= \frac{\cdot55}{25} - \cdot0153 = \cdot0067$ ohm.

Then distance of fault from B $= \frac{\cdot0067 \times 95 \times 3}{\cdot1057} = 18$ ft.

THE BRITISH ENGINEERING INDUSTRIES AND THE FISCAL INQUIRY.

III.—The Course of Ocean Freights During the Past Twenty Years.

The disappointment—a keen one—of the engineering manufacturer who turns to this section of the second blue book, is mitigated by the fact that its compilers iterate and reiterate the fact that their memorandum is only temporary and provisional, and promise further particulars. Absolutely no data whatever had been collected prior to the first volume, which gives only a single table of grain freights. The second volume gives tables covering a period of 20 years, which include a number of articles. Inward freights are given of the North Atlantic trade, including grain, meat and timber, of the Southern European trade, including grain and cotton seed, the Indian Ocean trade in general cargo, rice and sugar, and the Australian trade in frozen meat and wool. The outward freight rates for the Baltic, North Sea, Mediterranean and Black Sea ports apply entirely to coal, which exercises a predominant influence on freight in these classes of voyages, while the rates to the Atlantic coast of North and South America and New Zealand refer to textiles, iron and steel, and a variety of other goods. The trades covered by the inward freight statistics are rather more than half of all the trades in which these vessels engage, whilst, in the case of outward freights, the proportion included is roughly two-thirds. No statistics are given of the freights to and from South Africa owing to the complication due to the system of rebates. At a later stage information on this subject is promised. The omission of these tables is not regarded as vitiating the general conclusions at present arrived at, inasmuch as the tonnage of vessels entered and cleared to and from South Africa is less than one-twentieth of the tonnage embraced in the returns given in the present inquiry.

So far as the mean average tonnages for 1894 to 1903 are concerned, we may note that the inward tonnage of shipping from the Atlantic seaboard of North America averaged 6,205,610 tons, as against an outward average tonnage of 5,059,123 tons. The inward tonnage from the Southern European zones averaged 3,984,330 tons, as against an outward tonnage of 4,846,202 tons. Inward freight tonnages only are given for the Indian Ocean trade which averaged 1,551,163 tons. The outward average freight tonnage to Australasia amounted to 935,258 tons, as against 724,447 tons of inward freight.

Taking the mean value of the inward freights in 1900 as equal to 100, freights under this category have fallen from 121·7 in 1884 to 66·6 in 1903. As regards outward freights, taking again the mean value in 1900 as equal to 100, outward freight rates have fallen from 110·7 in 1884 to 78·9 in 1903. The fall has in neither case been a continuous one; for instance, 1889 was a year of higher rates than 1884, whence freights declined until 1895, after which they revived until a second maximum point was reached in 1900, when the war in South Africa made great demands on shipping for transport purposes. After 1900 rates collapsed, the figures for 1902 for both inward and outward freights being lower than in any other year of the series. While the figures collected afford a fair indication as to the course of the freight market, they give merely the average freight on a large number of articles and voyages. In particular cases it is well known that rates for the ocean carriage of goods are affected by a great variety of circumstances. The length of the voyage is, of course, an important factor, but it sometimes happens that the rate to a given port is lower than to another port many miles nearer home, the reason being that there is, perhaps, in the first case, the certainty of a return cargo, while in the case of the nearer port the outward freight may have to pay the expenses of the ship both outward and homeward. Thus the average freight on coal from the Tyne in 1903 is returned as 5s. 11½d. to Gibraltar, 5s. 9½d. to Marseilles, 5s. 3¼d. to Constantinople, and 5s. 1d. to Odessa. On trade routes where there are competing lines of vessels, rates may be lower (in proportion to distance) than on routes where there is a "conference" or agreement among the shipowners regulating freight charges. Again, the rates prevailing on particular voyages are occasionally subject to violent fluctuation by the entrance of a competing line into the trade which may cause a sudden fall in rates, followed, perhaps, by a fresh combination and an immediate rise in freights.

In addition to the coal freights, which occupy several columns, the mean yearly freight rates of certain articles of engineering interest are cited in three cases. For instance, the mean rate for plates, angles, and sheets from the United Kingdom to Montreal, which stood at 15s. in 1884, and by 1891 fell to 7s. 6d., remaining at this figure until 1902, when the rate rose to 8s., reaching 10s. in 1903. The mean rate for machinery for the River Plate fell from 40s. 8d. in 1884 for three years, rising subsequently to 48s. 4d. in 1889, fell to 23s. 8d. in 1893, and after several fluctuations rose to 35s. in 1901, a value at which it stood at 1903. The mean rate for cast-iron pipes for the River Plate, which stood at 33s. 3d. in 1884, stood at 28s. 3d. in 1903, its fluctuations having moved in close sympathy with the changes in the rate for machinery.

Interesting though this information is, it by no means suffices to give to the engineering manufacturer (or, indeed, any other manufacturer) in Great Britain information of real value. What is needed are comparisons of the rates on kindred articles, not only from the United Kingdom to distant parts of the Atlantic or Pacific Oceans, but also the ports at which the produce of our Continental rivals is shipped. In pursuing these inquiries over a period of years the staffs at our various Consular offices at Hamburg, Antwerp and other places will be well employed. When such information is forthcoming, the British manufacturer will be able to appreciate fully the nature of the services which State-subsidised lines render to his rivals. To labour further at a recitation of omissions or a narration of a series of desirable features in future reports were ungenerous in view of the frank manner in which the compilers of this section recognise the provisional nature of their present report.

POST OFFICE ENGINEERING DEPARTMENT, LONDON.

The second annual dinner of the above department was held on Friday, February 24th, in the Victoria Hall, Hotel Cecil, Mr. J. Gavey, C.B., M.Inst.C.E., engineer-in-chief of the Post Office, presiding.

The guests of the evening included Mr. H. Babington-Smith, C.S.I., secretary, Mr. J. C. Lamb, C.B., C.M.G., Mr. J. Ardron, Mr. A. F. King, Sir Robert Hunter, Mr. S. C. Hooley, I.S.O., Mr. J. C. Badcock, C.B., Captain R. H. H. Boys, R.E., D.S.O., Dr. Walmsley, Mr. A. M. J. Ogilvie, Mr. J. W. Willmot, Mr. W. Bosomworth, Mr. G. Morgan, Mr. A. W. Heaviside, I.S.O., and Mr. W. J. Etheridge, the company numbering about 200. Lord Stanley, the Postmaster-General, who was attending His Majesty's second Court of the season, was prevented from being present.

After the loyal toasts had been duly honoured, Mr. Lamb, in the absence of Lord Stanley, in proposing the "Engineering Department," said:—"As your chairman has told you, it is the unavoidable absence of the Postmaster-General that procures me the honour of addressing you to-night and proposing the toast of the evening but I am sure that I am speaking for him truly when I say that he cordially wishes you every prosperity, and that he regrets his absence quite as much as you do. If envy were a permissible thing, I think I might envy you engineers your association with those brilliant men, past and present, who have done so much to improve and facilitate and quicken communication in the world; but I think my envy might go further, because I see opening before you another field that you did not dream of years ago—a field in which you are to be associated with the men, both past and present, who have worked wonders for the transmission of power and energy in the world and for rapid transport. It is a development not merely in the outside world, but it is in the department itself; your sphere within the Post Office is being extended and enlarged; you are ceasing to be telegraph engineers; you are becoming more and more general engineers. But I think I appeal to your hearts more when I say that you are all proud to be telegraph men—not telegraph engineers, but telegraph men; and here I detect no envy in my mind, because I am one of yourselves. Well, gentlemen, speaking to you as one of yourselves, I say that we telegraph men have a sphere which is larger than that of any other body of men in the world. It is larger than that of the soldier; it is much larger than that of the ordinary civil servant. We are not limited to our own Empire. We go out in friendship and harmony to every corner of the world, and we find people ready to receive us as brothers. It has always been to me a pride and consolation that no matter where I go I find men who understand me. Even when I speak in broken language they apprehend what I mean, and are ready to welcome me, and this is the case with telegraph men all

over the world. I don't suppose I shall have the pleasure of being present at one of these dinners again, and therefore I take the opportunity of wishing you from the bottom of my heart an affectionate farewell. I now ask you to drink—you gentlemen here who do not belong to the Engineering Department—I ask you to join me in heartily drinking the health of the Engineering Department."

Mr. Gavey, in responding, said:—"In the first place, I know that I am only voicing your feeling of regret when I say how sorry we are that the Postmaster-General is unable to be here to-night. On the other hand, I may say on your behalf that we are very proud to see the permanent chiefs of great departments and the heads of so many branches around our table to-night. I think that for the benefit of the Service as a whole, the head of the great administrative departments of the Post Office, and the hands and brains that they direct in the shape of executive officers, should come into contact whenever it is possible. In a great service like the Post Office it is only on special occasions like this that such community is possible, and I hope it is a pleasure to the administrative heads to meet you to-night, and I am sure it is a pleasure to the executive officers to see those gentlemen, enthroned on high, of whom they can only form a definite opinion on occasions like this. Now, gentlemen, the thread of my thoughts has been diverted into a painful channel, by what I can only assume to be our friend Mr. Lamb's species of valedictory address. Those who, like myself, have been associated with the Telegraph Service for very many years, can hardly look back to the period of State control without the recollection of seeing the magical letters "J. C. L." at the bottom of papers. As time has gone by my appreciation of Mr. Lamb's talents, of his extraordinary knowledge of the telegraphs, not only of this country but of the whole world, has grown day by day. In fact, I think that he is absolutely the supreme authority on telegraphs throughout the whole of the world. If the time has arrived, or is about to arrive, when he bids farewell to the Service, I hope, and most sincerely hope, that he will not bid farewell to this company or to its successors. I am glad to say that our progress, both telegraphically and telephonically, appears to be very satisfactory. From the telegraphic point of view, I think I may say that the Post Office Telegraphs is certainly in the forefront, or if that may be considered too ambitious, I may say that it is not behind any other telegraphic service of the whole world. The Telegraph Administration of this great Department has always done everything to foster and encourage progress. In the course of the last year or two a number of experimental trials of the most advanced type of telegraph apparatus have been carried out. We have, in addition, forwarded that great work of the underground telegraphs to the North, and at the present time our lines may be said to be complete to Carlisle and to be on the verge of completion to Glasgow. In other words, during the last few years, we have laid something like 30,000 miles of underground wire to steady, and to make absolutely free from all climatic disturbances, the great trunk line service of the country. This work is to be continued so long as our paymaster, the Treasury, finds the funds. I am glad to say that those funds are provided for next year, so that for one year at least this progress is absolutely sure. In the matter of the extension of the London Telephone Service, which perhaps more closely affects many of the gentlemen who are here present, I am glad to say that we have made very solid and very steady progress. You will all remember that it was in February, 1902, that the first London Exchange was opened, with 250 subscribers. I find that on February 22nd of this year we had joined up 25,138 stations, and in the present year of that number 8,803 stations were provided. In the case of the trunk line service, the adjunct to the local service, or perhaps I should say the local service is the adjunct to the trunk line service, if we speak of the importance of the relative services and not of their numbers; we have to record continued growth. In 1897 shortly after the Post Office had acquired the trunk lines erected by the telephone company, and had commenced the extension of the service throughout the country, there were 47,855 miles of trunk line in use. At the end of the last financial year there were 102,752 miles erected, and the Post Office is steadily erecting from 7,000 to 8,000 miles of trunk wires every year. Now I come to another point which, no doubt, has exercised your minds more or less, and in which you have, no doubt, felt a considerable amount of interest. The agreement between the Post Office and the National Telephone Co. has now been laid before Parliament, and you are, no doubt, generally acquainted with its contents. You will have observed, of course, that the final acquisition of the company will take place in 1911. As an old warhorse who sniffs the battle from afar, I may say that, personally, I might have wished to have had my little share in that great transfer, but the fates and the wisdom of our chiefs have decided otherwise. So far, however, as you are concerned, and more especially the younger men that I see around me, I should like to offer a word of suggestion and a word of advice. I have a settled conviction that we are only on the threshold of this very great enterprise. The magnitude of the work that you, gentlemen, will have to carry out in future years is, perhaps, only appreciated by a few. To give you an illustration of what I mean, I should like to refer to the abnormal growth of telephones that has taken place in the United States within the last few years. For instance, I was in America in 1898, and in New York at that time there were 26,031 telephone exchange stations, the term station, of course, being well understood by all. I have recently received a letter from the general manager of the New York Telephones, who tells me that at the end of the year 1904 that 26,000 had increased to 140,000 stations in New York, and you will bear in mind that New York proper is not the greater New York, including Brooklyn and New Jersey. It is a little bit of an island 10 miles long by about 3 miles broad, with a population of about two millions. Again, taking the report of the American Bell Telephone Co., I find that in 1899, throughout the United States they had 465,000 subscribers' stations. In 1904, after an interval of five years, they had 1,525,000 stations. Now in this country the rapid growth of the telephone is of comparatively recent date, and the problems which you, gentlemen, will have to solve in the future, increase in magnitude as the square of the number of subscribers, and not as the numbers themselves Think, gentlemen, what you will have to consider in the year 1911. It will not be a question of intercommunication between 100,000 subscribers; it will be a question of intercommunication between a quarter of a million, with probably the possibility of having to provide intercommunication between half a million ten years later. It means that you will have to apply the highest technical and scientific knowledge that it is possible for men to obtain in order to do this work in a satisfactory and an economical manner; and what I want to suggest to you gentlemen, if you will not consider it an impertinence, and if you will not think that I am acting too much as the schoolmaster, is that, before the transfer takes place, you should fit yourselves, by keeping abreast with all the technical knowledge of the age, to take the position which you ought to occupy when that great transfer takes place. We have now in preparation at headquarters a species of technical summary of the theoretical principles on which telephony is based, and the lines on which the work ought to be done in the future. With the consent of our chiefs, I propose to have this printed and issued shortly, and I invite your careful attention to it—not by any means as a complete work, but rather as an index—a sort of direction post, pointing out the various paths in which you should carry out your investigations.

Mr. J. W. Woods, the superintending engineer of the Metropolitan Central District, in proposing the toast of "The Visitors," said: The members of the Post Office Engineering Department are always pleased to gather together in this quiet and homely way; and, like hospitable Britons, we like to have our visitors with us to taste our frugal fare. We have already heard, and heard with regret, that Mr. Lamb will soon be leaving the Service. I realise, and I am sure you realise, that the Service will lose a very true friend when Mr. Lamb goes. The Postmaster-General's position is buttressed and supported by secretaries, and we are very thankful indeed that Mr. Babington-Smith, "the secretary," has again come and graced our meeting. Mr. Babington-Smith is well supported by his secretaries—Mr. Lamb, Mr. Ardron, and Mr. King—whom I see before me, who are all supporting, very definitely and loyally, a chief who is worthy of their support. I am almost afraid, gentlemen, to mention another name, but there is an illustrious gentleman opposite me, Sir Robert Hunter. We do sincerely thank Sir Robert Hunter for being present—and we realise that in Sir Robert Hunter the Postmaster-General is well supported on the legal side. Before me I see also Mr. Hooley, the Controller of Stores. We honour Mr. Hooley because he has brought a department, on which every other department has to lean to a certain extent, to a state of great perfection. We are delighted to see Mr. Hooley at our table, and we thank him for the hard work that he has done since he has been the head of the Stores Department. I am delighted also to see Mr. Badcock, representing the Postal side. What should we do without the Postal side of our department? I see also my good friend Mr. Preston on the other side. We have to rub shoulders very often with Mr. Preston. Do not imagine for one moment that there is friction: we rub shoulders in the sense that we each put our shoulder to a wheel, and thus make the whole thing go. If you will allow me, I should like also to refer to two grey-headed veterans, Mr. Heaviside and Mr. Fleetwood. We greet them most heartily, and we trust that when our time comes to "sit down" we shall look as hale and hearty as our two friends. What I have lacked in eloquence, I have no doubt you will make up in heartiness in drinking the toast of "Our Visitors."

Mr. Babington-Smith, in reply, said: I have to thank you very warmly for the way in which the toast of the "Visitors" has been proposed by Mr. Woods and received by you. I thank you on my own behalf, and I thank you on behalf of my colleagues who are here as your visitors to-night, and on behalf of those distinguished strangers who are also your guests. I may mention, specially, Dr. Walmsley, to whose instruction the engineering service of the Post Office is much indebted. I may mention Mr. Murray—I am not sure whether I ought to call him a visitor, for I am glad to say that now he has at least one foot in the engineering service of the Post Office—and I speak also on behalf of the representatives of the distinguished firm of Siemens, to whose co-operation, in telegraphic matters, the Post Office is also so much indebted. The history of your service in the past has been a history of progress. That progress has been watched over from its infancy, I may say, by my colleague, Mr. Lamb. He assisted at the birth of the telegraph service of the State; he has watched over its growth, and though, to our very great regret, we are soon to be deprived of his great talents and his long experience, he may rest assured that his name will always remain associated with the great service of which he has for so long been a distinguished member. Your chairman has mentioned an agreement recently concluded, which, if it is confirmed by Parliament—as I hope it will be—will mean that the telephonic service of the Post Office will see a very great development some years hence. Not all of us, but I hope a great many of us, will assist at that development, and I should like to take this opportunity of saying that if that agreement has been made upon sound lines, if in settling the many technical points which arose in the negotiation of that agreement any satisfactory solution has been reached, it is in a very great measure due to the keen, scientific and large-minded insight with which your chairman advised the authorities of the Post Office on these technical problems. I have only once more to thank you very heartily, in the name of your visitors, for your kind welcome to-night, and to wish all prosperity in the future to the Engineering Department of the Post Office.

The musical programme, under the direction of Mr. H. J. Hoggarth, was of an exceptionally high order, and was contributed to by such well-known artistes as Miss Mabel Manson, Miss Edith Nutter, Mr. Webster Norcross, Mr. Harry Greene and Mr. Sivey Levey.

DISCRIMINATING CUT-OUTS.

By LEONARD ANDREWS.

THERE are a few points in Mr. Field's "rejoinder" in the ELECTRICAL REVIEW of the 11th ult., that call for some comment, but I will endeavour to be brief in dealing with them.

1. Certainly a sufficiently heavy leading current of ·7 power factor would cause a properly constructed discriminating relay to operate, but large currents of this nature do not occur in practice, except when a field fails.

2. Naturally, a cut-out constructed to operate when a generator field fails will do so, whether the failure of field be due to a breakdown, or to the accidental opening of a field switch by a careless attendant. It would be equally true to say that the accidental opening of a main switch would cut a generator out of parallel as certainly as if it were opened intentionally. The obvious remedy is to employ switchboard attendants who are not liable to make such mistakes.

3. Mr. Field thinks that a failing field does not necessitate the isolation of the faulty generator until it gets out of step with other generators, when he believes that the switch will be operated by the arrangement he recommends. He overlooks the fact that, before the faulty generator will break out of step, the bus-bar pressure will have fallen almost to zero, and other generators will be quite liable to run out of step before the faulty one is isolated.

4. Mr. Field contends that he can introduce "spurious phase displacement" in his wattmeter type of device, just as well as I can in the type of relay that I prefer to use. Certainly he can; it's just what I have recommended him to do from the first.

5. After exhorting engineers for many years to substitute the terms "healthy" and "faulty" for "forward" and "reverse" in speaking of alternating currents, I have, as Mr. Field points out, fallen into the old error myself. If he will substitute the word "healthy" for "forward" in the final paragraph of my last article, I think my meaning will be perfectly clear to him.

In conclusion, I must point out that, in my recent paper before the Manchester Section, I made no attack upon the wattmeter type of relay. Although I hold my own opinions as to the advantages or otherwise of this type of instrument, I prefer not to discuss this matter. I have only answered Mr. Field's attack upon my device, and in doing so have been obliged to explain my reasons for condemning the "reverse power" idea. Mr. Field now admits that his device will not isolate a generator without the introduction of "spurious phase displacement." As that was the only point I attempted to make, I am quite satisfied with this admission.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Earthing.

I have read with deep interest the abstract of the paper on "Earthing," read at Glasgow by Mr. W. W. Lackie, which appeared in your issue of February 17th.

I should be favoured by an expression of his and other's views on the matter of earthing of metal conduits in cases where some of these must be buried in plaster or concrete; the efficient insulating of the metal sheathing, which I understand Mr. Lackie to recommend, would be a somewhat difficult matter in such cases.

Recently I came across an installation in a church, where all the conductors except the main cables were composed of twin 1/18s, paper-insulated and lead-covered, and fastened direct to stonework and woodwork with metal saddles. It occurred to me that the earthing of the metal sheathing of these conductors was thus not very efficient, unless it happened to touch a gas pipe somewhere, which was quite likely in such a building. I should be glad to hear what Mr. Lackie thinks are the most likely risks of such an installation, and if these risks would have been obviated or minimised by the methods advocated in his paper.

B.

A Chief's Complaint.

My committee have, after three years' service, recently asked me to supply them at every meeting with a time sheet, recording how I employ my time, and the number of hours engaged daily on the hundred and one different items which are a portion of every Chief's sinecure (?). I consider this to be an insult, more especially as the results of the past year should bear ample evidence to the fact that their interests have not been neglected.

Would other chief engineers kindly express their views?

Chief Engineer.

[Our correspondent has our sincere sympathy.—EDS. E.R.]

Rotary Converters.

In Mr. A. E. Eborall's well-known lectures, the Howard Lectures on Polyphase Electric Working, delivered in 1901, the following sentence occurs on page 39:—"Transformers supplying current to rotary converters (which are never paralleled on the three-phase side) should always be mesh connected."

On one of the London electric railways there are two rotary converters in each sub-station, fed by six single-phase mesh-connected transformers; the transformers are always in parallel on the H.T. and L.T. sides, and both rotaries are fed from a common set of three A.C. bars and are also in parallel on the D.C. side.

Mr. Eborall would almost certainly have known of the system when he wrote the lectures, and I think he must have been using the words (in parallel) with a different meaning to that generally given.

Perhaps some reader would kindly explain why they ought not to be spoken of as being in parallel, when running as above.

Balderstone A.I.E.E.

Temporary Wiring in Ball Rooms, &c.

We were exceedingly surprised, on reading your article on the above in last week's issue, to find that statements are made which were proved to be false at the trial, and we ask you in common fairness to give us an opportunity of pointing out the misstatements, which we cannot think have originated with your own staff.

In the first place, from your article it may be inferred that we are of the "draper and general middleman type, undertaking electrical contracts." As a matter of fact, our electrical department is a distinct organisation from the rest of our business, and is under the control of a thoroughly competent, technical and practical electrical engineer, an associate member of the Institution of Electrical Engineers, who has had 18 years' practical experience in first-class firms. Our stock and methods have been specially designed for temporary lighting under expert advice, and we have been entrusted with very large contracts in such places as Buckingham Palace, Marlborough House, Guildhall, &c. We, therefore, claim that your definition of "draper middleman," &c., is an improper term to apply to us, and that as the caterers were fully aware of our record, and our special capabilities for such work, they cannot be accused of subletting the contract without taking proper precautions that it would be properly executed.

You say, "Some alterations were made in the way of fitting up some large electric fans." Whilst not actually untrue, this is expressed so as to convey an exaggerated idea of the fans. They were 12-in. ordinary enclosed motor

fans, and the wires for them were tested with the rest of the installation.

"The fire breaks out immediately after a trial demonstration, and no one saw the outbreak." It was proved in Court that the whole installation had been running without any mishap of any kind for about 2 hours during the afternoon, and that from 10 to 15 minutes elapsed after all the lights, except one centre fitting 30 ft. away, had been switched off, before the fire broke out, and that three witnesses saw the first appearance of fire at a spot 18 in. from the nearest electrical conductor.

With regard to Col. Crompton's evidence, the premises on which he based his opinion were entirely theory, and, as proved in evidence, theory based on error. He thought that the garlands contained 23 8-c.p. 200-volt lamps in a circuit with 10-ampere fuses, whereas in fact they were 20 5-c.p. 200-volt lamps with 5-ampere fuses. He also stated that it was a moral impossibility for an expert wireman to get 140 No. 40 wires into each hole of the S.B.C. holders without stray ends. We not only proved that it was physically possible, but the jury themselves were able to do it easily. As this was his great point as to the danger of the system of looping, the opinion of Mr. Dykes and Mr. Mordey that the system is perfectly safe is at least as worthy of consideration, and they stated that so far from the work being "slipshod," they were convinced that every care was taken and the work thoroughly well done.

It has been stated that the muslin was draped about the lamps. This was denied in Court, and it was proved that the garlands were hung on pegs 6 in. long, projecting from the top of the walls, and were further stayed out by clips, so that no lamp was within 6 in. of any muslin. But for fear of trespassing too much on your space, we could point out other inaccuracies in your article.

In conjunction with our clients, Messrs. Kingston and Miller, we fought the matter out fairly and openly, having nothing to fear from an impartial investigation. The evidence conclusively proved that from the position of the outbreak, it was impossible that the fire could have been an electrical one.

The fact of the jury only requiring 10 minutes to come to a unanimous verdict in our favour shows that, so far from "giving us the benefit of the doubt," they were satisfied that we had carried out the installation in a proper manner.

Simmonds Bros., Ltd.

London, *February 24th*, 1905.

[The defendants in this action were the firm of caterers, Messrs. Kingston, Miller & Co., to whom we referred as middlemen, and they were obviously such, seeing that they employed Messrs. Simmonds Bros. as sub-contractors. The latter, though not the defendants in the case under review, were defendants in an action brought against them by Messrs. Kingston, Miller & Co., which was standing in abeyance pending the decision in the Lionel Phillips case, and it was obviously in their interest to assist their clients, as, if Messrs. Kingston, Miller & Co. had been beaten, they would probably have found a remedy against Messrs. Simmonds. As to our correspondents' reading of the evidence, it would be best to refer to the judge's summing up, for the learned judge conclusively showed that he took the Lionel Phillips view of the case. Our opinion, to which we adhere, was that the jury arrived at a mistaken but quite understandable verdict which did not accord either with the judge's view or with the tenour of the evidence.—Eds. E.R.]

Enclosed Arcs.

I read, with pleasure, your comments, in the issue of Friday, the 25th inst., on the paper read before the Society of Architects; but I think that you are in error when you state that in a modern high-class enclosed arc lamp, the arc does not travel slowly from one part to the other of the space between the carbons.

I have had experience in testing most of the latest types of this class, and have always found that the arc does travel about in this way. This is quite apparent from observation of a lamp while burning, as well as from an inspection of the spent carbon ends. These will be found to contain numerous small craters, where the arc has established itself at various times.

In some of the miniature lamps, which have carbons about 5 mm. in diameter, the arc sometimes even travels a good way up the side of the positive carbon.

G. W.

On Dumping.

I am glad to see that your correspondent, Mr. Arthur Ker, practically admits that Protection raises prices (at least this is a corollary to his argument). This accounts for his not having seen the point he deals with advanced "even in serious discussions," for most Protectionists try to avoid admitting that prices rise under Protection.

Now, if the electrical industries were the only ones to be protected, they would, of course, be benefited. But if all industries are to be protected, and therefore the prices of all commodities increased, the net effect would simply be to reduce the purchasing power of money.

Arnold Maude.

Chelmsford, *February 27th*, 1905.

Re the Third Rail.

In one of your editions at the beginning of this year Prof. Silvanus Thompson stated "That on two occasions in this country the third rail had been abandoned in favour of the overhead system." The Professor, I believe, said "They were railways"; but a perusal and search through your valuable journal has failed to inform me which ones they are, and perhaps Prof. Thompson will kindly inform me through your valuable paper. Could you kindly tell me why the present positive third rail is always laid outside the railway track metals instead of bteween, as in the case of the Liverpool Overhead, &c. Where does the advantage lie? To my mind it would appear as if it could be better protected when laid between the tracks as formerly.

Good Old Third Rail.

[The railways in question are those in the north of Ireland, the earliest examples of electric traction in the United Kingdom—between Bessbrook and Newry, and Giant's Causeway and Portrush, respectively.—Eds. E.R.]

A.C. v. D.C.

I should like to draw attention to what appears to me to be a great absurdity on the part of advertisers requiring assistants. One frequently notices in such advertisements statements similar to the following:—"Applicants must have had experience in the working of a three-wire continuous-current system."

I think it cannot fail to be admitted by electrical engineers that a man who is conversant with the practical working of an alternating system is perfectly qualified to take charge of direct-current plant, on the ground that the greater includes the less.

In my opinion it should be distinctly realised that alternating-current experience is the higher grade, and that consequently a man possessing it is fully qualified for direct-current work.

W. Talboys Wheeler,
Second Assistant,
Corporation Electricity Works.

Tunbridge Wells,
February 27th, 1905.

[Doubtless all A.C. men will agree with our correspondent. There are, however, about four times as many D.C. stations in this country as A.C., and the engineers in charge of them may possibly have views slightly divergent from his.—Eds. E.R.]

[A correspondent wants to know who are the makers of small electric crucibles suitable for gold or platinum.—Eds. E.R.]

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"Surprised" writes:—"We shall be glad if you would kindly give us your opinion on the following:—A client of ours, who at the present takes current from the Corporation mains, proposes pulling down his own plant, but wishes to keep the Corporation supply available in case of breakdown. We have seen the Corporation, and if this is done they require a guarantee of about £20 per annum irrespective of the amount consumed; the installation is 44 16-c.p. lamps. Can this be legally enforced?"

*** With reference to this query one point is quite clear, namely, that the Corporation can impose no terms upon "Surprised" which are intended to prevent his merely using the Corporation mains as a stand-by. In other words, they cannot ask him to give the suggested guarantee, unless they have the right to do so under the existing conditions. Whether they can do so or not under existing conditions depends upon the terms under which the supply was granted in the first instance. It is very likely that "Surprised" has been under an obligation to take a minimum quantity each year since he first became a consumer. He can satisfy himself upon this point by reference to the contract which he signed; it may have escaped his attention owing to the fact that his supply bill came to more than £20. Should it transpire that there is no obligation to take a minimum quantity, it seems that the Corporation are now making an unjustifiable demand.

"G. H. P. M." writes:—"Will you kindly inform me whether it is legal to insert a penalty clause in a contract in case of the failure of a contractor to complete work in a given time? The contractor is, of course, to have full knowledge of the penalty clause previous to tendering for the work. I am told that such a clause is illegal, and cannot be enforced in law, yet apparently such penalties can be enforced by the Government."

*** Penalty clauses are frequently inserted in contracts and are certainly not illegal. Whether the contractor has full knowledge of the penalty clause before he tenders is quite immaterial, inasmuch as he could always refuse to sign a contract which contained a penalty clause. It is probable that the notion of "illegality" in relation to the penalty clause arises from the fact that when a penalty clause has been inserted in a contract and a breach has been committed, the full amount reserved by the penalty clause is not always recoverable. For instance, if the damages sustained are capable of being accurately assessed, it is probable that the full amount reserved by the penalty clause would not be recoverable. In the case which is troubling our correspondent, it is probable that the amount of damage caused by delay would be wholly impossible to assess. In that case the full penalty may be exacted. It is to be observed that the penalty clause in a contract has nothing to do with the *bonus* clause. A contract may contain a penalty clause without a *bonus* clause, or *vice versâ*.

LEGAL.

Norwich Corporation *v.* Norwich Electric Tramways Co

Lords Justices Vaughan-Williams, Romer and Stirling, on 23rd ult., heard the appeal of the defendants in the action of the Mayor and Corporation of Norwich *v.* the Norwich Electric Tramways Co., against the judgement of Mr. Justice Phillimore. The plaintiffs sought to recover £53 odd, money paid by the Corporation for the repair of roads said to have been injured by the defendant company, and both parties sought a declaration of their rights under the Norwich Tramways Act, 1897. The Act incorporated provisions in the General Tramways Act, under which the company had to keep in good repair to the satisfaction of the local road authority, (1) so much of the road as lies between the road lines of the tramway, (2) if there were two tramways belonging to the company within 4 ft. of each other, the portion of the road between the two tramways, and (3) so much of the roadway as extends 18 in. beyond the rails on each side of any such tramway. If the company failed to comply, the Corporation must, after seven days' notice, open and break up the road, and do the necessary works at the expense of the tramways company with interest at 5 per cent. The Act also provided that wherever the road authority, the Corporation in this case, altered the level of any road on which the tramline was laid, the company should, at the same time, alter its rails to level them with the altered surface of the road. If this was not done and the lines became a danger to public traffic, a penalty of £5 10s. could be imposed. It was further provided that when there was a less space than 3 ft. between the footpath and the tramway rails, the company should pave and maintain the road. In some cases the tramways were laid in granite setts in macadam roads, and at the point where the macadam became worn lower than the granite, a ridge was formed into which the wheels of vehicles sank and water accumulated, making the macadam rotten and soft. The Corporation had repaired these ridges, the company denying their responsibility, on the ground that the surface of the macadam was bad and the whole of it was in need of repair. Mr. Justice Phillimore had found that, while the macadam might have been in better repair in the greater number of cases, it was in sufficiently good repair. The sub-section was difficult to construe, but on the whole, he thought that the fact that macadam wore away more quickly than granite, had been considered in the legislation that had been carried out, and that it was intended to throw upon the tramway companies, as a condition of the privileges given them, the duty of maintaining the even contour of the road by a proper junction of the two surfaces. He, therefore, gave judgement for the plaintiff Corporation for £53 with 5 per cent. interest. He also made the following declaration in favour of the Corporation:—"That the obligation of the company under Sec. 57, sub.-Sec. 5 of the Norwich Electrical Tramways Act, 1897, to maintain and keep in good condition the junction therein mentioned, extends to cases where, by reason of the presence of the tramways in a road, the traffic in such road has caused the surface, laid and maintained by the Corporation, to become worn down below the level of the paving laid and maintained by the company, and involves the maintenance by the company of a uniform and unbroken contour of such surface immediately adjoining such paving, or the lowering of the pavement itself."

Mr. Danckwerts, K.C., in opening the case, said this was an appeal from a judgement of Mr. Justice Phillimore, tried without a jury at Norwich. There were two questions which arose in the case. One being a question which unhappily was not raised in the Court below, but he was bound to call the attention of the Court to it. That question was whether the High Court had any jurisdiction in the matter whatever. It was a case something like that of Crosfield *v.* the Manchester Ship Canal Co. The other point was a question as to the construction of a provision in the private Act of Parliament with regard to the extent of the liability of the Tramway Co. for whom he appeared.

Lord Justice Vaughan-Williams said that the case of Crossfield *v.* the Manchester Ship Canal Co. was in list for argument before the House of Lords that day.

Mr. Danckwerts said that was so. The defendants were a Tramway Co., and they were authorised to run tramways through the city of Norwich under a special Act which incorporated the Tramways Act, 1870. It had been held that questions arising under the Section, between a body like the Corporation and a body like the Tramway Co. should be referred to and decided by a referee appointed by the Board of Trade, and that the Court had no jurisdiction. The case raised an important point. The action was brought to recover a sum of money which had been expended by the Corporation in alleged or disputed default of the Tramway Co. to do certain repairs, and for a general declaration as to the extent of the Tramway Co.'s liability to repair. Mr. Justice Phillimore did make a declaration, and that question was a very important one, because it not only took away from the referee appointed by the Board of Trade in this case, the very questions which under the Act were to be referred to him, but it took away his jurisdiction in other cases. That raised a very serious question. The money matter in the present case was trifling. The important part of the decision was the declaration; therefore he was bound to take the point. Under the General Tramway Act, the Tramway Co., whenever it laid a tramway in a city, town, or elsewhere, was obliged to repair the road and maintain the roadway with such materials and so forth as the road authority required, and to the satisfaction of the road authority—that was to say, they were obliged to maintain the roadway between the rails and for 18 in. on each side of the rails, and, where there was a double line of tramways, the space between the rails as well. In this Act of Parliament the 4-ft. limit had been done away with, and in certain narrow streets the tramway company was bound to maintain the whole width of the street. In addition, the company was bound to lay the rails so that the upper surface of the rail was not above the level of the surface of the roadway. The Tramway Co. had to maintain the roadway with such materials as the local authority required, and to its satisfaction. Their Lordships would notice that in that particular case the tramway was laid along a strip of granite paving, and the rest of the roadway was made of macadam. The granite portion of the pavement, under the legislation he had mentioned, had to be repaired by the Tramways Co., and the macadam by the Corporation. There were various other kinds of roadways. For example, the roadway might be paved with wood, or the whole might be granite, or the tramways part of wood, and the Corporation part of granite. But in this particular case the question had only arisen with regard to the macadam. There was a section in the Act which said that if the Tramway Co. failed to maintain and keep in repair the junction between the surface of the Corporation's part of the roadway and the Tramway Co.'s part, certain consequences would follow. The question was, what was the meaning of the word "junction?"

Lord Justice Romer: They seem to have foreseen the difficulty. You may look after your part of the road, and get it nice and perfect, and the Corporation may look after theirs, and so far as it is looked at by itself, it cannot be complained of. But through wearing down, there may be a difference in level at the junction. They cannot both do the necessary work, because they would interfere with each other. It must be put on someone, and they say it must be put on you.

Mr. Danckwerts said if it was merely the maintenance of the junction, he should not object, but the Corporation went a good deal beyond that. Where there was granite and wood which did not marry properly, there might be an opening up at the point of junction, and that was what they had to prevent. But the Corporation sought to construe the Act solely with regard to macadam, and said the Tramway Co. must maintain the surface of the macadam for the necessary distance in order to keep a level contour.

Lord Justice Vaughan-Williams: I think Mr. Justice Phillimore's judgement means that the obligation on the Tramway Co. is to maintain the contour of the road.

Mr. Danckwerts: They have, in fact, mended their macadam part of the road, and sought to charge us with the cost.

Lord Justice Vaughan-Williams: I should have thought that an engineer was the very person to say whether in a particular instance it was necessary to do that.

Lord Justice Romer thought it was particularly a case which should have been taken to the Board of Trade. The question was whether, as that course had not been adopted, the jurisdiction of the Court had been ousted.

Lord Justice Vaughan-Williams: If you had been a private individual instead of a company, there would have been no necessity for an action at all. Whenever a corporation and a company are in conflict, I do not know whose fault it is, but at once an abundant stream of unnecessary expense commences to flow.

Mr. Danckwerts: The reason is because the surveyor of the Corporation tries to throw upon the tramway company as much as he can of the repairs. That is the secret of the whole thing.

In answer to a question from the Bench, Mr. McMorran said all that the Corporation contended was that the company was bound to see that there was not an actual dip at the line of junction, and that it must be sloped off, perhaps 2 or 3 in., perhaps 6 or 7, but far enough to prevent its being a straight drop down.

Mr. Danckwerts said that was not what they had claimed, and produced a photograph showing work done, for which the Corporation claimed payment of the entire cost.

It was again suggested from the Bench that the matter should be brought before the Board of Trade, and Mr. Danckwerts said he would make his friend an offer. The amount in dispute was a small one, which the company would be willing to pay without prejudice to the general question, and set aside all that had happened in the Court below. There were some roads now about which the Corporation had given notice, and the company had asked for arbitration to the Board of Trade; and if it was possible in that case, they could get legitimately before the Court, the arbitrator stating his award in the form of a special case.

Mr. McMorran, however, was unable to accept the offer. They would have to throw away everything they had done, and they would not get any further forward.

After some discussion, however, it was arranged that the hearing should be adjourned until the decision had been given in the House of Lords in the case of Joseph Crosfield & Sons, Ltd., *v.* The Manchester Ship Canal Co. on the point of jurisdiction. The appeal therefore stood over generally, with liberty to either party to apply to restore it.

Jandus Arc Lamp and Electric Co. *v.* Arc Lamps, Ltd.

In the Chancery Division of the High Court of Justice on Tuesday, Mr. Justice Kekewich delivered his reserved judgement in this case.

His Lordship said that, as usual at the conclusion of the arguments in a patent case, he found that the primary object of decision was to construe the specification—that was, to ascertain from the patentee's own statements whether the monopoly which he alleged the defendants to have infringed was thereby sufficiently described and claimed—but one was met here with the preliminary question, What was the specification which it was the duty of the Court to construe? The original specification had been largely amended, and the amendments had been effected merely by the erasion of certain passages and words. Amendments might be made thus, or by the addition of language modifying the original, or by the substitution of new language for some erased, or by a combination of all or any two of those methods. Here there was simply erasion. The question was whether, for the purpose of construing the specification as it now stood, which was undoubtedly the instrument to be construed, his Lordship was at liberty to read and consider the erased language. Considering it as a question of principle, it admitted of only one answer. The intention of the parties to a document must be ascertained from the language in which that intention is expressed, and there was no reason for treating a specification differently from other documents, whether it be regarded as a grant by the Crown, or a contract between the patentee and the public. Here the amended specification was the document on which the plaintiffs were suing, and which the defendants contended was either invalid or did not disclose an invention which they had infringed; and therefore, unless an exception could be established in favour of documents of this particular character, the amended specification alone could be read in order to ascertain the true construction thereof. It was, of course, often necessary in construing one document to refer to others. For instance, in construing an Act of Parliament, one frequently had to refer to earlier Acts on the same subject, and in construing rules of the Court one had to refer to old rules, but this was done in order to instruct the mind respecting the circumstances under what Act was passed or the rules were made, and not otherwise to affect the construction. There was at least one authority which supported his Lordship's view. He referred to Hattersley *v.* Hodgson, 21, Patent Cases, 517, where the Master of the Rolls said: "It is a matter of history in this case that the original specification has been amended and certain parts of it have been deleted, but in construing this specification I propose to omit those parts that are deleted, and in doing so I think I am acting on the authority of the House of Lords." Proceeding, his Lordship said that even if his view of the principle be incorrect and his conclusion from the authorities erroneous, he thought the Patent Act, 1883, Sec. 18, precluded the defendants from referring to the erased lines in support of their argument on the construction of the amended specification. That enactment enabled applications for leave to amend and opposition thereto to be heard by the Comptroller with a right of appeal to the law officer, and provided for by Sub-Sec. 8 as follows:—

"No amendment shall be allowed that would make the specification as amended claim an invention substantially larger than or substantially different from the invention claimed by the specification as it stood before amendment."

This standing alone might not prevent a contention that an amendment allowed was, notwithstanding the allowance, irregular, but that was set at rest by Sub-Sec. 9, which was:—

"Leave to amend shall be conclusive as to the right of the party to make the amendment allowed, except in case of fraud, and the amendment shall in all Courts and for all purposes be deemed to form part of the specification."

Did not that exclude the reference to the erased lines for which the defendants contended. In order to answer that question, it was necessary to ascertain for what purpose the defendants desired to refer to them. If his Lordship apprehended the argument correctly, it amounted to this: It might be that, on the true construction of the amended specification standing alone, the plaintiffs were right, and that there was to be found in what they said the patentees claimed; but if the Court read the whole original specification, it would see that on the construction of the whole there never was in it what was now said to be in the amended specification, and it would be found that what was alleged to be in the amended specification could not have been established. In other words, the defendants said that, by erasing certain lines of his specification, the patentee had made what remained claim something which was not claimed before; that was, to make the amended specification claim an invention substantially larger than or substantially different from the invention claimed by the specification as it stood before amendment, and that was precisely what the Statute said should be conclusively negatived by the allowance of the amendment. In Moser *v.* Marsden, the House of Lords distinctly decided that such a reference to the erased parts was impossible. His next duty was to ascertain the meaning of the amended specification. It was a somewhat verbose document, and shared the common defect of specifications, for, notwithstanding a full description of the manufactured article to which it referred and of their practical operation, assisted by figures on which no question arose, there was a strange want of precision and lucidity in the language employed, and the claims were not so framed as to aptly fit the invention described. That on which special stress was laid in the description was omitted from the claims altogether. Nevertheless, the point for decision was a narrow one. The object of the alleged invention was, first, to increase the life of carbons in arc lamps, and, secondly, to improve the quality of light. With the second of these objects his Lordship really was not concerned. A fair proportion of the specification was devoted to it, and it might or might not be that the inventor's anticipations of success in this direction had not been realised, but that did not touch the question here in issue, which was only concerned with the increased life of the carbons. That was intended to be effected by enclosing the carbons in a glass envelope carefully closed, but leaving at the top a small aperture through which the heated air of the envelope could escape so as to prevent explosion. So far he had in his own language described that about which there was no contest, but the plaintiffs said, and unless they could say so truthfully, they could not maintain their action that the glass envelope must be small, and that smallness, as well as lightness, was of the essence of the invention. It was reasonably clear on the evidence that a small envelope was essential to complete success, but the question was whether this was clearly stated in the specification. It was impossible to treat this question as one of easy solution. The figures undoubtedly pointed to a small envelope, and that might be taken in aid of imperfect description in the letterpress, but, on the other hand, the claims contained no reference whatever to smallness, and although that was not a fatal defect, one must attribute some weight to it. It was, to say the least, strange that a patentee should omit from his claims, which were numerous, all reference whatever to an essential part of his invention. All objections and criticisms notwithstanding, his Lordship was of opinion that the patentee knew that a small envelope was essential, and that if not the sole advance, it was intended to be the main advance on previous knowledge, and that he had said this in sufficiently explicit terms. In the outset of his description of the manner in which he carried out his invention, he stated that he made the envelope "sufficiently small in size." It was an awkward expression, because sufficiently ought to be followed by language explaining for what the smallness was to be sufficient, but it was left entirely at large. Still, it was a distinct indication that the envelope must be small. Further down on the same first page he said: "I am enabled to make the transparent or translucent enclosing envelope, three inches or less in diameter." On the second page, when describing his invention by reference to figures, he spoke of a transparent or translucent envelope, preferably made of glass, and not to exceed three inches, and preferably less in horizontal diameter, and of any desired length, and on p. 3 he said that the small arc-enclosing envelope prevented dissipation of the gases, and maintained them at a greater degree of density than would be possible with a larger envelope. His Lordship thought those passages read in connection with the rest of the description, not merely indicated the patentee's view that a small envelope was desirable and an improvement, but stated that his invention was not complete without it. His Lordship was entitled to regard the common knowledge at the date of the patent. The patentee told them the necessity of an air-tight envelope had been recognised, though all efforts to produce it had, so far as he was aware, resulted in failure, but there was no statement that the size of the envelope had received consideration, and they knew, in fact, that the value of this simple improvement had not been grasped. Assuming that

smallness was an essential part of the invention as described, there was a further question whether smallness was sufficiently defined. He had already mentioned that the patentee began by speaking vaguely of an envelope sufficiently small in size, and the patentee afterwards spoke twice of an envelope 3 in. or less in diameter. Was he to be restricted to an envelope of that size? The question was an important one, because in practice it had been found that an envelope of a rather larger diameter produced better results, and was commercially used. One must bear in mind the object in view, namely, to increase the life of the carbons, and what his Lordship understood the patentee to mean was that if you could employ an envelope of 3 in. or less in diameter you would thereby increase the life of the carbons to the maximum possible. Then knowingly, as he clearly did, that the smaller the envelope the greater was the risk of explosion, he did not mean to incur that risk to a dangerous degree. What his Lordship really understood him to say was this—make your envelope 3 in. or less in diameter if you can without destroying its utility, but at any rate, make it so small that it will be useful in increasing the life of the carbons. His Lordship's conclusions, therefore, was that an envelope of, say, 4 in. in diameter, otherwise constructed according to the specification, was sufficiently described therein, and might fairly be said to be made according to the plaintiffs' invention.' This comment on the specification had been devoted mainly to the element of smallness, because on that the discussion had chiefly turned, but the requisition of tightness must not be left out of sight. It was insisted on in the clearest manner possible, and always with the proviso that the envelope, though practically tight, must allow a steady outflow of gases from the lamp. Perhaps the patentee did not really know why by combining tightness and smallness there could be attained results which had hitherto been unattainable, but he saw that it could be done, and told the public how to do it. Utility had been challenged. There was no question but that lamps constructed more or less on the lines of the Howard patent had been used and sold in large numbers, and had proved a commercial success. The defendants, by imitating the plaintiffs, had themselves given the strongest testimony to this conclusion; but it was said that what had proved commercially useful had not been really a lamp contructed according to the Howard patent, but one which constituted an improvement thereon, and with such difference as made the two things distinct. In support of this it was urged that the essential result—that was the increased life of the carbons—could be, and, in fact, had been, attained without following the directions of the Howard patent, and it was practically certain that no lamp constructed strictly in accordance with that patent had been in commercial use. On either side there had been conducted a number of experiments; those experiments had been proved, and a good deal of time had been spent in examining and cross-examining the witnesses who proved them. The result to his Lordship's mind was to show the utter futility of experiments conducted in the manner in which they had been conducted in this case. For the purposes of research, a man must, of course, work alone in his own laboratory, but for the purposes of evidence intended to carry weight with a tribunal concerned in determining such a question as here came up for decision, something far different was required. Although his Lordship did not for a moment suggest that on either side there had been any intention not to act fairly, or to avoid discovery of the truth, it was really impossible to ascertain by cross-examination why there had been obtained, firstly, by one, and then by the other, results at variance with the experience of those by whom the particular experiment was not made. It was suggested on behalf of the defendants that some experiments should be made by an independent expert. His Lordship did not see his way to direct that to be done, and reflection convinced him that it would have been useless to direct it. Experiments by an independent man, however skilled, and however trustworthy, would not be satisfactory, because neither party would be quite sure that the experiments had been conducted precisely with the materials, and in the manner alleged to be necessary for a complete test. Perhaps an independent expert might be of assistance in this manner. He might watch the experiments made, first by one party, and then by the other, and inform the Court whether both classes of the experiments had been conducted with that identity of material, and of all surrounding circumstances, which was essential if it was desired to test one class of experiments by another. But nothing of that kind had been done. His Lordship was convinced that no safe conclusion should be rested on the experiments, except, indeed, the one that they were inconclusive. Turning from the experiments to the other evidence on the question of utility, he had already noticed that lamps had not been made, and certainly had not been commercially used strictly according to the Howard's patent. The patentee's notion that his lamps would require a lower voltage than other types of lamps, had been contradicted by experience, and the methods described by him for securing the necessary tightness, had given way to others who had been found more effective. It might be that in some other matters there had been a departure from the terms of the specification, and that those departures had not merely assured the success of the manufactured article, but had aided to increase that success beyond the sanguine anticipation of the patentee. Nevertheless it seemed to his Lordship clear on the evidence that the plaintiffs had constructed and largely used lamps which were in their essential character Howard lamps, and that the variations were merely accretions, which notwithstanding that they were such improvements that no one would now think of making lamps without them, yet did not destroy or reduce to a negligible quantity the essential characteristics of the Howard lamp. As to the question of infringement, there really was no doubt that the lamps manufactured by the defendants were substantially identical with those manufactured by the plaintiffs. There were differences of detail, of course, but in what he had termed the essential characteristics of the Howard lamp they really were identical. If there were no such essential characteristics, or if the variations and improvements which experience had dictated so altered the character of the lamp that it could no longer be properly regarded as constructed according to the Howard specification, then of course the defendants were entitled to succeed, but if his view on these subjects was right, it necessarily followed that the defendants had infringed the patent vested in the plaintiffs. He would now consider the question whether the patent had been anticipated. In support of their contention that it had been anticipated, the defendants put in several prior specifications, and strongly relied on more than one of them. Nevertheless his Lordship thought it necessary to mention one only, namely, that of Beardsley, 1882. It might be that if Howard's invention was anticipated by Beardsley it was anticipated by others also, but his Lordship was satisfied that if Beardsley's patent was no anticipation, no other was worth consideration. Beardsley no doubt came near to Howard, and as admitted by Mr. Swinburne, he had the idea to which practical effect was afterwards given by Howard. He saw the value of tightness and the necessity of combining that tightness with a contracted aperture for the escape of heated gases from the enclosing envelope. But he did not see the importance of making that enclosing envelope small. It was obvious from a perusal of his specification that this never occurred to him. Therefore he could not be said to have anticipated Howard unless it be true that as urged on behalf of the defendants, a competent workman might produce a Howard lamp with Beardley's specification alone to guide him. It was admitted that no one ever did this, and the same remark was applicable to the other specifications on which the defendants relied. That, of course, was not conclusive, but it was of some weight. There might be a complete and unanswerable paper specification of a patent, and if one be produced it would not avail the patentee to say that no one had ever put it in practice. But when, as here, it was well known that the particular object was highly desirable of attainment, and that the attainment thereof would ensure commercial success, then the fact that an alleged paper anticipation, intended to attain that very object, had never been put in practice was a remark strongly tending to the conclusion that the alleged anticipation was not complete. But it was urged that, although it had never been done, a competent workman might, and readily would, produce as good a lamp as those used by plaintiffs and defendants, with Beardsley's specification as his only instructions. That might be true, and, indeed, on the evidence his Lordship thought it must be true; but there was a fallacy in the statement when used to support the argument that Howard was anticipated by Beardsley. Since Beardsley's time there had been a large advance in the common knowledge of those versed in such matters, and it by no means followed that the competent workman of 1882 could or would have produced a lamp which would come easy to the workman of to-day. The Howard patent was dated August, 1893, and the question was whether at that time 11 years after Beardsley's patent, the latter would have enabled a competent workman to construct a lamp according to Howard's specification and with the advantages which he secured. The evidence convinced his Lordship that the advance of knowledge had not at that time been sufficient for that purpose. Beardsley did not instruct the public that a small enclosing envelope was essential to secure the desired result—that was, to increase the life of the carbons, and no one had discovered this before Howard. As to the question of subject-matter, it struck his Lordship from the time Mr. Terrell first explained the nature of Howard's invention, that there was a difficulty in supporting a patent for it. The difficulty had haunted his Lordship throughout the case, and his conclusion on this point had been arrived at with more hesitation than any other. His Lordship could not help thinking that, in order to support Howard's patent as regarded subject-matter, it was necessary to go at least as far as had ever been gone in that direction. It was true that Howard combined tightness and smallness, and that both were required to produce a lamp having the effect that he contemplated, but the necessity of tightness was thoroughly known before, and what he really discovered was the necessity of smallness. Kay *v.* Marshall, 2 Webster's Patent Cases, was cited as a conclusive authority against the plaintiffs, but it seemed to his Lordship that the real objection to the patent there was that the particular mode of using the spinning machine which was sought to be protected was known before, and that that was really the explanation of the whole case. Might it not fairly be said that Howard discovered means of using the enclosing envelope, the benefit of which the world had not known before, when he said that to make it really useful it must be made smaller than any which had, up to then, been employed. The decisions in the Edison cases were useful towards the support of the patent, for, as his Lordship understood them, they showed that the merit of Edison's invention consisted wholly in the use of a carbon thinner than any one had used previously, and yet his patent was upheld. In Lane-Fox's case Lord Justice Lindley laid down a rule, which he repeated in Moser *v.* Marsden, 10 Patent Cases, 358. Holding in the latter case that the patent was bad for want of subject-matter, he applied the following remarks made in Lane-Fox's case:—

"A man who discovers that a known machine can produce effects which no one before him knew could be produced by it, may make a great and useful discovery, but if he does no more his discovery is not a patentable invention. He has added nothing but knowledge to what previously existed. A patentee must do something more, he must make some addition, not only to knowledge, but to previously known inventions, and must so use his knowledge and ingenuity, as to produce either a new and useful thing or result, or a new and useful method of producing an old thing or result."

Of course, it might be said with some force that, in prescribing a small envelope, Howard made no addition to previously-known inventions, and in one sense that was perfectly true, because enclosing envelopes were well known, and it might be taken for granted that there was no difficulty in making them small; but still Howard did discover what was not known—namely, that a small envelope was required in order to increase the life of the carbons—and thus he gave to the world a new and useful method of producing a result highly desired, but until then incapable of attainment. This was an addition to previously known inventions within the meaning of Lord Justice Lindley's rule, and sufficient to support a meritorious patent. The plaintiffs, in his Lordship's judgement, were entitled to the relief usual in such cases, and the costs of the action.

PARLIAMENTARY.

London County Council Tramways Bill.—Mr. Whitmore, Sir Fredk. Banbury, and other London members intend moving the omission of the clauses giving the L.C.C. powers to construct tramways along the Embankment, when that Bill comes up for second reading.

Standing Orders.—On Friday the Examiner found that further Standing Orders had been complied with in the case of the following Bills:—Baker Street and Waterloo Railway, Andover Lighting and Power Bill, Great Northern, Piccadilly, and Brompton Railway (No. 2), Whitechapel and Bow Railway, Weybridge and Walton-on-Thames Electric Supply Bill, Edgeware and Hampstead Railway Bill, and the Charing Cross, Euston and Hampstead Railway Bill.

On Monday, amongst the Bills which were found to have complied with Standing Orders in the House of Commons was the Dublin United Tramways Bill.

Standing Orders in the House of Lords were found on Monday to have been complied with in the case of the South Lancashire Tramways, Metropolitan Railway, Blackpool, St. Annes, and Lytham Tramways, Mexborough and Swinton Tramways, Oldham and Saddleworth District Tramways, Tyneside Tramways and Tramroads, Central Electric Supply, and the County of London Electric Supply Co.

Royal Commission on London Locomotion.—Replying to Mr. Schumann, Mr. Akers Douglas states that he is informed by the Royal Commission appointed to inquire into the means of locomotion and transport in London that they are now considering their report, but cannot state exactly when it will be presented.

Heckmondwike Improvement Bill.—The Standing Orders Committee of the House of Commons recommend that standing Orders be dispensed with in the case of this Bill, and that the parties be allowed to proceed, provided that Clauses 10 and 11 be struck out of the Bill. Clause 10 confirms an agreement made with the British Electric Traction Co. with reference to the supply of electricity in bulk, and Clause 11 empowers the Council to supply electrical energy within parts of Liversedge and Batley.

Wigan Corporation Bill.—The Standing Orders Committee have considered the report of the Examiner with reference to the non-compliance of the Wigan Corporation Bill with Standing Orders, and have resolved that the parties be permitted to proceed with the Bill, provided that the powers to construct tramway No. 2 be struck out unless the consent of the Aspull U.D.C. can be proved before the Select Committee which will consider the measure.

Coventry Electric Tramways.—The promoters of this Bill have intimated that it is not their intention to proceed further with the Bill. The object of the Bill was to extend the time granted to the Coventry Electric Tramways Co. to reconstruct existing tramways for electric traction.

BUSINESS NOTES.

Trade Mark Protection in the United States.—Messrs. W. P. Thompson & Co., patent agents, of 6, Lord Street, Liverpool, write as follows:—

We have received an advance copy of the Trade Mark Registration Act which has just passed the legislature of the United States. Hitherto the trade mark practice has been very chaotic, as a trade mark could not be registered unless used in commerce with Indian tribes or with foreign countries, and resident traders trusted to unwritten common law for protection. The new law differs from the British in the following points:—

No foreign trade mark can be registered until registered in the country of its birth.

Only citizens of the United States, and citizens or subjects of other countries granting similar terms to the citizens of the United States, can register a trade mark.

Registration lasts for 20 years for the marks of American citizens. The marks of foreigners are only registerable for the remainder of the period for which registration is granted in their own countries, but in no case for over 20 years. All registrations can be renewed at the end of the term, provided, in the case of foreign marks, their home rights are correspondingly renewed.

Foreigners registering marks must appoint some agent resident in the country as their representative, upon whom notice of proceedings affecting the right of ownership can be served, and the serving of notice on such agent shall be held to be equivalent to serving it on the owner of the trade mark.

The restrictions as to what can be registered are substantially the same as in Great Britain, with this exception, that any mark in use in commerce with the United States, which has been in exclusive use as a trade mark by the applicant or his predecessors in business for the 10 years immediately preceding the passing of the Act, can be registered.

The rules for hearing oppositions and appeals are a great improvement on those in Great Britain, but in all other important points the law of the two countries as regards registration of trade marks is substantially similar.

The Agricultural Hall Motor-Car Exhibition.—The tenth annual International Motor-Car Exhibition organised by Mr. C. Cordingley, which is to be held at the Agricultural Hall, London, N., from the 18th to the 25th inst., promises to be by far the largest so far held in this country, the list of exhibitors comprising close upon 300 different firms. Not only will most of the principal British motor-cars be on view, but there will be a very fine display of all the leading French, German, Belgian, Dutch and Italian cars. Perhaps one of the most important sections of the exhibition will be that devoted to heavy commercial vehicles. This section is under the patronage of the Motor Van and Wagon Users' Association, and will not only comprise the largest array of heavy steam and petrol wagons so far seen in this country, but will include a number of motor-omnibuses. So far as electrical vehicles are concerned, it must be admitted that the entries are small, but the section will not be without interest, as in addition to the Krieger carriages, a new electrical car, and also an improved accumulator is, to be shown for the first time by the Ekstromer Accumulator Co. The galleries of the Agricultural Hall will be devoted to a display of motor-car accessories, of which small accumulators, coils and other ignition specialities will form a not unimportant part.

Fynn Single-phase Motor.—In addition to the particulars given last week, relating to the Fynn motor installed by Mr. Pringle at Burton, we are informed that the temperature rise of the hottest part, after four hours' run at 15·5 H.P., was only 65° F.; the motor is rated at 14 H.P.

Football.—On Saturday last the half-yearly match between the Robertson lampmakers and the head office staff of the General Electric Co. was played on the ground of the Robertson lampmakers. Owing to the fact that the lampmakers had won every year since the match was first instituted, the headquarters staff turned up in full force with a firm intention of vanquishing their opponents on this important occasion. The lampmakers, on their part, had made up their minds that they would still hold a clean certificate. The game was fast and furious, and on one or two occasions the brotherly love which should exist between fellow employés was conspicuous by its absence. The lampmakers were victorious by 3 goals to 2, winning goal being scored by a penalty in the last half-minute of the game, much to the disgust of the headquarters staff. The football match was followed by the annual concert in the dining hall at Brook Green Works. The concert was attended by considerably over 500 people and was a great success.

Fire Alarm.—The Danish Minister, M. de Bille, the Danish Consul, and a number of Danish gentlemen, attended an official fire test at the British Fire Prevention Committee's testing station the other day, when a Danish automatic fire alarm system was under investigation.

The Transvaal.—The value of the electric cable wire and fittings imported into the Transvaal during the 11 months ending with November last, is returned at £65,000, as compared with only £60,000 in the corresponding 11 months of 1903.

Sturtevant Works for Bedford.—The Sturtevant Engineering Co., Ltd., of 147, Queen Victoria Street, London, has acquired 7 acres of land at Bedford as a site for the erection of new works.

Dutch Trade Marks.—Messrs. W. P. Thompson & Co., of 322, High Holborn, W.C., write:—

The following amendments to the Dutch Trade Mark Law, which became law on January 1st last, may have interest for those of your readers who own foreign trade marks.

1. Priority of date (within six months of actual filing) may be claimed for trade marks already used at a recognised Exhibition in any State adhering to the International Convention for the protection of Industrial Property.
2. If the colour or colours of a mark constitute an essential feature thereof, this should be stated and additional coloured representations be filed.
3. The time allowed to the Trade Marks Office for acceptance or rejection of applications is extended, likewise the opportunity for action in the Courts for removal of a mark from the Register.
4. Old marks applied for prior to 1893 and not then completed may be proceeded with provided application to proceed be lodged before April 1st, 1905.

For Sale.—The Hereford County and City Asylum authorities offer cables, Simplex tubing and fittings for sale. King's Norton Union invites offers for the purchase of a battery. See particulars among our advertisements to-day.

Catalogues and Lists.—Mr. A. H. Mitchell, Elevator Dock, Silvertown, E., has sent us an illustrated list of the Mitchell-Williams patent compensating derricking cranes for all purposes to which jib cranes are applicable. The sole makers of these are Messrs. J. M. Henderson & Co., Aberdeen.

We have received from The Lawrence Patent Water Softener and Steriliser Co., Ltd, Norland Works, Uxbridge Road Station, W., a copy of their new catalogue, which gives full particulars of the Lawrence process for softening and sterilising hard and impure waters without the use of chemicals. A new type of exhaust steam softener and feed-water heater is also described therein. An expanding tube steam trap made by the company follows out a principle largely adopted in these devices; the tube is of bellows formation, the arrangement altogether being very simple.

Messrs. Bayliss, Jones & Bayliss, Ltd., 139—141, Cannon Street, E.C., and Victoria Works, Wolverhampton, have issued a new price list of "Helicoid" nuts and "Bright" bolts fitted with these patent nuts.

Messrs. Griffiths Bros. & Co., Marks Road, Bermondsey, S.E., have issued a pamphlet dealing with their "Armacell" insulating varnish.

From Messrs. Staunton & Co., Blythe Street, Bethnal Green, E., we have received a pamphlet describing a new tramcar speed

indicator they are now prepared to supply. The instrument registers total number of miles travelled, indicates rates of speed at any moment and automatically registers the maximum speed reached during the last 110 yds., or 220 or 440 yds., if so desired. The space on the axle required for the driving gear, is about 6 in. to 8 in.; the spindle of the pinion wheel is connected to the indicator spindle by means of flexible shafting. A second indicator, showing M.P.H., is supplied to run at the opposite end of the car so that the driver has an indication of speed at both ends.

The Brush Electrical Engineering Co., Ltd., Belvedere Road, S.E., and Loughborough, have sent us a copy of their Bulletin, No. 10, which is exceptionally well got up. It treats of transformers, and illustrates the various parts in detail, sectional drawings, full specifications and prices being also given.

Messrs Siemens Bros. & Co., Ltd., York Street, Westminster, have sent us a brochure dealing with electrical equipments for cranes and capstans, and also a leaflet detailing their various manufactures. The former is well printed on art paper and profusely illustrated. Diagrams of connections are given, with line drawings of solenoid brake magnets, controllers and motors; and tables of power and dimensions, together with efficiency curves of the company's "C"-type motors are also included. To those interested in electrically operated lifting machinery and capstans, we commend this list. Messrs. Siemens Bros. & Co. have also sent us explanatory pamphlets and diagrams relating to dry-core telegraph and telephone cables made under Dieselhorst & Martin's patent; by this system it is possible to super-impose circuits with entire freedom from cross-talk.

We have received from Messrs J. H. Holmes & Co., Portland Road, Newcastle-on-Tyne, an up-to-date list of ship and yacht electric lighting installations which they have carried out.

Messrs. Hamblet's Blue Brick Co., Ltd., West Bromwich, have sent us a leaflet relating to Parke's patent triple aeration and drainage slabs.

A list has come to hand from Messrs. Fuller, Macleod & Co., Ltd, Norfolk House, Laurence Pountney Hill, E.C., relating to the dry cells and portable testing batteries, &c., manufactured by Messrs. Hellesens Enke & V. Ludvigsen, of Copenhagen, for whom the former company act as sole agents for Great Britain.

We have received from the Electrical Co., Ltd., Charing Cross Road, W.C., pamphlets and a number of illustrated sheets. Electrical winding engines, and electrical power in weaving mills are dealt with, and a leaflet describes an automatic cut-off switch for shop windows, &c. The switches are fitted in circuit with the lamps, and a clock set to switch off at any desired hour, the apparatus consisting of an ordinary alarm clock in combination with a 20-ampere switch of the company's "royal" type.

Messrs. J. H. Butcher & Co, Birmingham, have sent us a catalogue of their transfers, which they supply for machinery, tramcars, &c.

Mr. E. Brook, of Threadneedle Street, Huddersfield, has sent us a list of his E.B.H. single-phase alternating-current motors for low and standard speeds, such as he is making for several corporations. He has also issued a small booklet giving useful hints and information for users of electricity for lighting and power.

Book Notices.—"Science Abstracts." Sections A—Physics, and B—Electrical Engineering. February 25th, 1905. Index to Section B for Vol. VII., 1904. London: E. & F. N. Spon, L'd. 1s. 6d. each.

"The Insulation of Electric Machines." By Harry W. Turner and Henry M. Hobart. London: Whittaker & Co. 10s. 6d. net.

"Steam Pipes: Their Design and Construction." By W. H. Booth. London: Archibald Constable & Co. 5s. net.

"Motoring Annual and Motorists' Year Book for 1905." London: Motoring Illustrated. 5s. net.

"Eliminating Isolation and Distance from Farm Life." Paper read by Mr. F. De Land before the Kansas State Board of Agriculture at Topeka, U.S.A.

"Peat and its Products: An Illustrated Treatise on Peat and its Products as a National Source of Wealth." By W. A. Kerr, V.C. Glasgow: John Smith & Son. 6s.

"Jahrbuch der Elektrizitäts-Gesellschaften sowie der Strassenbahnen und Elektrischen Kleinbahnen Osterreich-Ungarns." Edited by Rudolf Hanel. Vienna: Alfred Hölder.

"Leçons sur l'Electricité." By Eric Gerard. Vol. II. Seventh edition. Paris: Gauthier-Villars. 12 fr.

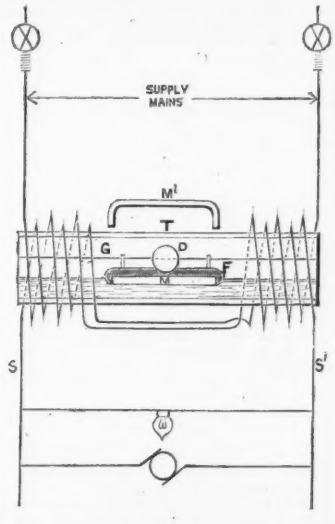
"Fortschritte der Elektrotechnik." Edited by Dr. Karl Strecker. 1904. II. Berlin: Julius Springer. M. 7.

"On a New System of Wireless Telegraphy." By Alessandro Artom. Proceedings of the Royal Academy of Lincey.

Gas Producers for Power Purposes. By W. A. Tookey. London: Percival Marshall & Co. 1905. Price 1s. net.—This handy little book of 137 pages is described as "A Handbook for the use of Purchasers, Erectors and Attendants." It contains 21 very clear diagrammatic illustrations, with three tables, and is written in non-technical language. As it is impossible to judge of the value of a work by its title, we may say that Mr. Tookey's little book will be found of great assistance to all students, prospective purchasers, and users of gas producers for power purposes. A special feature of the work is the suction gas producer, the appendix containing diagrams of 13 different plants, with detailed descriptions of the various parts of the apparatus, so that comparisons can be made and the merits claimed for the respective systems considered. Besides clearly explaining the manufacture of power gas in producers, a chapter is devoted to hints for attendants, including full instructions for working suction producers, which indicate that the author is quite familiar with the actual working arrangements as well as with the design and requirements for each special application. Every page contains useful information, written in a simple style readily understandable by a schoolboy, but of practical service to all interested in the gasification of fuel and the application of the gas for power purposes, and anyone making himself familiar with the contents will feel satisfied that he seldom gets so much practical knowledge at so small a cost.

Photography for All. By W. J. Harrison. London: Iliffe & Sons. 1904. Price 1s. net.—This is an excellent elementary text-book which contains practically all that the amateur need know in order—with practice—to become an efficient photographer. It is divided into two parts, the first giving details of all the essential processes up to the production of the finished "silver print," and the second dealing with higher flights, such as hand camera work, the newer developers, printing on bromide and platinum papers, &c. Very many of our readers are more or less given to dabbling in the art, and we have pleasure in recommending this work to them as one of the most practical and useful that we have seen.

Automatic Insulation Testing Device.—The accompanying illustration shows the arrangement of the device mentioned in our last issue by Mr. J. W. Manley, the inventor (Eldon Street House, E.C.). The apparatus is applicable to all installations where both conductors are insulated, whether D.C. or A.C., and may also be used in central power stations to supplement or replace the Hopkinson two-lamp indicator, whose function it closely parallels. The current from the supply mains passes through conductors, of which a few turns are wound round the ends of a glass tube, T; the tube contains a liquid upon the surface of which a float F supports a small magnet M, a guide G preventing the float from clinging to the side by capillary attraction. A disk D is attached to the float, to indicate its movements. The float is controlled by a magnet M^1, so as to stand normally central when the insulation of the circuit is unimpaired, the currents in the coils neutralising one another's action. If now a leakage occurs on



either side of the system on the leads S or S_1, whether a load is on or not, the go and return currents in the coils will no longer be equal, and the float will be attracted towards that side on which the leakage occurs, the displacement being approximately proportional to the magnitude of the leak, and being permanent so long as the leak exists. Directly the leak is removed, the float returns to the mid-position. If both sides of the circuit are faulty, the float will move towards the side on which the greater leakage exists—the case of exactly equal leakage of any material magnitude is so unlikely to occur for any length of time, that it need hardly be considered. An alarm signal or automatic cut-out can, of course, be easily operated by contacts made by the float at suitable positions in its travel.

The apparatus is very simple, and not likely to get out of order; we have seen a model of it appreciably affected by an artificially-produced leakage of $\frac{1}{10}$ ampere, and obviously a growing leak would be distinctly indicated long before it attained a magnitude capable of doing injury. The importance of preventing or detecting leakage to earth has recently been emphasised by Mr. W. W. Lackie, and this neat device of Mr. Manley's may prove a valuable safeguard against such risks.

The Holborn and Finsbury Electrical Exhibition.—The approaching Exhibition of the County of London Electric Supply Co. promises to be a success. There are to be 60 exhibitors from among the leading manufacturers and wiring contractors, &c. Holborn and the immediately surrounding boroughs are the headquarters of many notable industries, and it is to these trade interests that this Exhibition addresses itself. Stated briefly, the purpose of the Exhibition is to illustrate the suitability and the adaptability of electric power to every branch of manufacture. The County of London Electric Supply Co. supplies electricity to these districts, and there is naturally a great demand for it as a motive power to drive machinery. The Exhibition should be an excellent means for bringing in the many manufacturers who are still using antiquated methods. By visiting this Exhibition they can see machines similar to their own in actual operation, driven by electricity, and satisfy themselves of its efficient working. Motor-

driven printing presses, sewing machines, cold-storage plant (for butchers), lathes, polishing heads, &c., for clockmaking, will all be in evidence.

Trade Announcements.—Messrs. Bray Markham and Reiss, Ltd., Blackhorse Lane, Walthamstow, have appointed Messrs. Rees & Wilson, Wards Buildings, 33, High Bridge, Newcastle-on-Tyne, as their sole agents for the counties of Northumberland, Durham and the Cleveland district of Yorkshire. Communications can be sent either to Messrs. Rees & Wilson, or direct to Walthamstow.

Messrs. G. J. and A. Bonnella have recently started in business as Bonnella Bros., at 40, Rosoman Street, Clerkenwell, E.C., as ivory, ebonite and hardwood turners, specialising as manufacturing electricians. The former gentleman has had a long and practical experience, and thoroughly understands the needs of the trade.

Mr. Arthur Peckett, of Bristol, has joined Mr. H. W. Umney in partnership at 46, King William Street, E.C., where they will carry on the business of civil, mechanical and electrical engineers, merchants and agents, as also representing the five following engineering firms:—Messrs. Isaac Storey & Sons, of Manchester; The Sunderland Forge and Engineering Co.; Messrs. Rubery & Co., of Darlaston; Messrs. Pollock, Whyte & Waddel, of Johnstone, N.B.; Messrs. J. and O. G. Pierson, of Paris.

Owing to the continued growth of business, the Pantelegraphy Publishing Co., Ltd., has again moved to larger premises at 20, Copthall Avenue, and 62, London Wall, E.C. The company has sent us a pamphlet containing particulars of the latest developments of its system of pantelegraphy.

Messrs. D. H. Bonnella & Son, Ltd., ivory, bone and wood turners, of 58 and 60, Mortimer Street, Cavendish Square, London, W., ask us to give publicity to the following statement:—"Our attention has been called by several of our friends to a circular emanating from a firm who have recently commenced business under a name similar to that of our company. . . . We take this opportunity of informing you that the firm in question has no connection with us whatever, and that our business is being carried on under the same personal management, and at the same addresses as heretofore.

Messrs. Monté-Callow & Co., of 6, Broadway, E.C., have resigned their agency for Messrs. Lionel Robinson & Co.'s specialities.

Mr. Alf. Geo. Jackson has taken up the management of the Synchronome Co., of Australasia—the company which has bought out the Australasian rights from the London Synchronome Co., and has agents in each of the States. Its address has been changed to 65-69, Ann Street, near George Street, Brisbane. Mr. Alexander Knox, the managing director, who has already installed some large electrical time-circuits in Queensland with the assistance of Mr. A. G. Jackson, the technical manager, is at present on a visit to this country to perfect his arrangements with the manufacturers.

The Unbreakable Pulley and Mill Gearing Co., Ltd., of Manchester, intimate that their Preston representative, Mr. John Lucas, has removed to 76, Brackenbury Road, Moor Park, Preston.

Bankruptcy Proceedings.—The public examination was held last Tuesday before Mr. Registrar Linklater at the London Bankruptcy Court, of Harry Arthur White, lately trading as Ridout & Co., at 45, Highgate Hill, N., electricians. The statement of affairs shows liabilities £1,198 16s. 6d., of which £1,148 14s. 10d. is expected to rank against assets £25 5s. 8d. Under examination by Mr. Walter Boyle, Assistant Receiver, the debtor stated that he formerly managed the business for Mr. Ridout, and in March, 1903, he took it over, agreeing to pay £100 for the stock, and £500 for the goodwill, by instalments, as and when he could spare the money. The business was not then a paying concern, but he hoped to make it so, and he did not understand that he was giving £600 for an insolvent business, because it had a valuable connection. In May, 1903, he undertook the installation of electricity, and to put in ventilating fans, at the Hornsey Town Hall for £260. A condition attached to the contract was that he should purchase all materials from the General Electric Co., Ltd. They, however, failed to supply the fans in time, with the result that he exceeded his time for completing the work, and the Hornsey Borough Council withheld a balance due thereupon. Witness estimated that he lost £100 altogether by the contract, but, in addition, he lost the Council's electrical work, which he would have retained had the General Electric Co. carried out their part of the contract, as the Council were perfectly satisfied with his work. In June last he removed the stock to Messrs. Knowlmann's premises, under an arrangement that he should work them up an electrical branch to their business. He did not file his petition when he found that he was in difficulties, because he did not wish to go into the Bankruptcy Court, and hoped to get through his difficulties. Having regard to the fact that he started business on borrowed money, he had to admit that he had been insolvent throughout his trading. The examination was concluded.

Olympia Motor Show.—It is announced that the Society of Motor Manufacturers and Traders has decided to hold its next Exhibition at Olympia in the late autumn, at which all classes of vehicles and motor-boats may be represented.

Brush Contracts.—The following contracts have recently been booked by the Brush Electrical Engineering Co., Ltd.:—Four car-bodies, with radial trucks and B.T.H. equipments for the Pietermaritzburg Corporation; 10 double-deck car-bodies with single trucks and Brush motor equipments for the Yarmouth Corporation.

Liquidations.—On 13th inst. a resolution for voluntary liquidation was passed by Bryan Donkin & Clench, Ltd., Mr. A. G. Webb, of Chesterfield, being appointed liquidator.

The creditors of the Electrical Fittings Co., Ltd., are required to send particulars of their claims before the 31st inst. to the liquidator, Mr. J. D. Patullo, of 65, London Wall, E.C.

LIGHTING AND POWER NOTES.

Aberdeen.—The Gas and Electricity Committee is to consider and report on the advisability of abolishing the maximum demand indicator system of charging, in favour of a uniform rate.

Arbroath.—The Empire Electric Light and Power Co. has written to the T.C. protesting against the treatment which it is receiving at the hands of the Council, in regard to the electric lighting of the town, and the company states that it reserves its right to claim damages for loss.

Aston.—The Electricity Committee has recommended the T.C. to abolish the two-rate system of charging for E.L., and to adopt the following scale of charges:—Consumption under 300 units per quarter, 3¾d. per unit; 300 and under 600 units, 3½d.; 600 and under 1,000, 3¼d.; 1,000 and under 1,500, 3d.; 1,500 and under 2,000, 2¾d.; 2,000 and upwards, 2½d.

Beckenham.—Legal advice is to be obtained by the U.D.C. in regard to powers to supply energy outside its district.

Bexhill.—The electrical exhibition recently held at the Kursaal has proved very successful. On Thursday last week, the mayor presided at an electrically-cooked luncheon, at which the electrical engineers of Hastings, Eastbourne and Brighton attended. The *Bexhill Chronicle* issued an illustrated supplement relating to the exhibition with its issue of the 25th ult.

Bexley (Kent).—The U.D.C. has altered the day motor tariff as follows:—Not exceeding 90 units per quarter, per H.P., 3d. per unit; 180 units per quarter, 2d. Meter rents have been fixed as under:—One (1,000 watts), 2s. 6d. per quarter; five (1,000 to 5,000 watts), 3s. 6d.

Cardiff.—Recently a L.G.B. inquiry was held relative to the application of the T.C. for a loan of £87,868 for E.L. purposes. There was strong opposition from the Property Owners and Ratepayers' Association, its contention being that public lighting could be done better and cheaper by gas.

Carnarvon.—The public opening of the electrical works took place on the 23rd ult. The work has been carried out by the National Electrical Construction Co., the Corporation advancing some £16,300 for the works and £1,000 for the purchase of the site. The capacity of the works is 10,000 8-C.P. lamps, and applications for some 3,000 are in hand. The engines were started by the ex-mayoress, and the mayoress switched on the light for the first time. Subsequently a dinner was held to commemorate the event.

Continental Notes.—FRANCE.—La Société Grenobloise de Force et de Lumiére is at present establishing a noteworthy power transmission plant, for which the constant direct-current (Thury) system has been adopted. The contract for the plant at the generating stations has been placed with the Compagnie de l'Industrie Electrique et Mecanique, of Geneva. Altogether 6,300 H.P. is to be transmitted from Montiers to Lyons, a distance of 180 kilometres. A part of the energy is intended for the operation of the tramway system in Lyons at a pressure of 600 volts. The balance will form a supplement to the existing three-phase supply at 25,000 volts pressure. To this end the rotary transforming sets are to be made reversible, in such a way that in case of need the three-phase system may supply the continuous system, and *vice versâ*. This forms one of the features of the installation, as it is stated to be the first occasion where two such dissimilar plants can be called in to assist one another at such a great distance. Another important point is the penetration of the primary main into the Lyons district by underground cables several kilometres long at a pressure of over 50,000 volts. The plant at the generating station at Montiers will, for the present, consist of four units of 1,600 H.P., each comprising a turbine connected up to two C.I.E.M. dynamos. There will thus be eight dynamos, each capable of generating a current of 75 amperes at 7,200 volts. They are to be coupled up in series giving a total pressure of 57,600 volts, and 4,320 KW. capacity. The dynamos are series excited, six-pole machines, and are arranged to run at variable speeds according to the demand, the maximum speed being 300 r.p.m. The generating station is exceedingly simple in arrangement; there is no switchboard, and the only regulating device is that acting directly on the inlet to the working turbines, and for each dynamo a simple interrupter, voltmeter and ampere-meter. The 180-kilometre transmission line will consist of two wires, 9 mm. dia., extending as far as the outskirts of Lyons, from which point underground armoured cables are used. At Lyons the H.T. current is converted to low-tension current (600 volts). The rotary transformers are arranged to run at a constant speed of 428 r.p.m, each giving 500 KW. In another sub-station—a coupling and reserve station for the two systems—two 500-KW. transformers will at first be installed; they will run either as motors or generators, and will be coupled up to a synchronous three-phase machine, also arranged to run as generator or motor.

The Compagnie Générale de Distribution d'Energie Electrique has acquired a site on which it will erect a power station. The motive power will be furnished by the Dordogne, and part of the energy generated is to operate the tramways of Bordeaux. The plant will also supply energy for lighting to different towns.

SPAIN.—Application has been made for a concession to put down a plant to utilise certain available water power at Villasante in the generation of electrical energy, and to transmit the same to Bilbao for lighting purposes.

Bishops Stortford.—The U.D.C. has intimated that it is prepared to enter into negotiations with the Bishops Stortford and Stansted Electric Lighting Co. for the transfer of its electric lighting order.

Electric Driving in Cotton Mills.—The Acme Spinning Co., of Pendlebury, near Manchester, is equipping its new premises for electric driving and lighting. The mill will contain 41,000 mule and 34,000 ring spindles, as well as the usual preparation machinery. It will be a mill of six storeys, and equipped throughout with the most up-to-date appliances known. There is an added interest in this case, inasmuch as the supply is to be given by the Lancashire Electric Power Co. Energy at a pressure of 10,000 volts three-phase, will be taken into the special fireproof transformer chamber provided; the supply to the motors will be at 400 volts three-phase, and four-wire three-phase distribution at 230 volts will be used for lighting. As turbines are used for driving the dynamos at the power station, a very perfect drive should be obtained on the spindles, which, of course, is a matter of vast importance in the spinning industry, as thereby increased production can be obtained, and the product itself is also improved in quality. As this new mill is being built side by side with a steam-driven mill of the same proportions, and under the same management, a very useful comparison will be instituted.

Failsworth.—The Council having had inquiries for a supply of electric light, has decided to communicate with the Manchester Corporation electricity department in reference to a supply of energy to Failsworth.

Greenock.—At a meeting of the T.C. recently, the convener of the Electricity Committee reported that the increase in the demand for energy during the past year was equal to the capacity of the last addition made to the plant. A meeting is to be called to consider the question.

Halifax.—Following upon a report by Mr. W. M. Rogerson, the electrical engineer, on the condition of the mains, the T.C. has authorised the Electricity Committee to purchase 40 four-way disconnecting boxes, at an estimated cost of £400. The electrical engineer strongly urges the Committee to set aside any profits there may be at the end of the current year for the renewal fund, as further sums for the renewal of mains are likely to be required. He states: "I should like to see this fund stand at the least at 10 per cent. on the capital outlay of about £230,000 at the present time. The sum of £2,500 was devoted to the relief of the rates last year, but I do not think we are yet in a position to afford any money for the relief of rates until the renewal fund shows a larger margin."

Hull.—A Sub-Committee of the T.C. has been formed to consider a scheme for obtaining motors for letting out on hire. The Council has no power to borrow money for this purpose.

The E.L. Committee has resolved to extend the E.L. mains to the Sanatorium, at an estimated cost of £780, on condition that the bill for energy shall not be less than £160 per annum, for three years.

Kent.—The Kent Electric Power Co. has completed the purchase of the Chatham, Rochester and District Electric Lighting Co.'s undertaking as from January 1st last.

Kingston.—As a result of the decreased charges for energy during the past year, the department received £650 less from its old customers, but practically equalised the loss by increased output.

London.—City.—The Streets Committee has submitted a report relative to the proposal of the Charing Cross and Strand Electricity Supply Corporation, to change the pressure from 100 to 200 volts in those portions of the Western area where a supply of 100 volts is now being given, the object being to make the supply of uniform voltage throughout. It recommends that the company should make, at its own expense, the necessary alterations to consumers' lamps, &c., and allow a deduction of 10 per cent. in the price of energy to consumers whose supply is changed, and it is suggested that the company should establish proper means of testing the public and private supply of energy.

Fulham.—The Electric Lighting Committee of the B.C. reported on Monday, that it had decided in favour of fixing the charge for energy for private lighting at 3½d. per unit, with a discount of 5 per cent. on quarterly accounts of £2 and upwards, and 7½ per cent. on quarterly accounts of £20 and upwards. Under the existing scale of charges the average price paid last year by private consumers was 4·18d. Electric mains are to be laid in seven roads, at an estimated cost of £315. Thirty gas lamps in these roads are to be converted into incandescent electric lamps, at an estimated cost of £52 10s.

Wandsworth.—On Monday, the General Purposes Committee of the B.C. reported having considered a letter received from the County of London Electric Supply Co., Ltd., in reply to a communication from the Council, asking whether the company would be prepared to hand over to the municipal authority the Streatham area of its undertaking upon terms, or to purchase in bulk, electricity generated at the Tooting dust destructor. The company replied that the Streatham area formed the centre of its distributing system, and therefore the sale of that area would sever the undertaking into two separate portions and involve great interference with the supply in the remaining areas. Further, the company's generating station is so far from the Tooting destructor that the proposal for purchasing electricity generated thus, appeared to be practically impossible. The Committee has resolved—(1) That the company be informed that having regard to the fact that energy is generated at Wandsworth and transmitted to Streatham and there transformed, it appears to the municipal authorities that the energy generated at Tooting, could profitably be used by the company. (2) That it be suggested to the company that it would be an advantage to them to purchase the electricity generated at Tooting for the purpose of lighting the streets in question. The same Committee further reported having considered a letter from the engineer of the L.C.C. giving particulars of pressure tests made on the circuit in the borough of the County of London Electric Supply Co., Ltd., also stating that the company had notified that if the B.C., as consumers, wished to keep a check upon the pressure of supply, the company would be pleased to arrange suitable positions in Clapham and Wandsworth, where recorders can be fixed. The Committee decided that the company should be called upon to provide testing stations in accordance with the provisions of their prov. order, when the necessary tests could be made.

Southwark.—The following system of charges will come into force with the commencement of the Midsummer quarter:—Lighting, maximum demand, 6d. for the first 1½ hours, and 1d. afterwards. Flat rate, 4½d. per unit. Power, maximum demand, 3d. for the first hour, and 1d. afterwards. Flat rate, 2½d. per unit. Discounts are to be allowed on the foregoing, thus:—On quarterly bills of £50 or under, 2½ per cent.; £50 to £100, 5 per cent.; £100 to £200, 7½ per cent.; over £200, 10 per cent. The Committee further reported having given careful consideration to a letter from the L.C.C. drawing attention to the undertaking given in connection with the electric light loans, to the effect that the B.C. will "provide out of a sinking fund established for that purpose, or from maintenance account, for all renewals and replacements during the currency of the loan, of any of the plant or machinery provided with the proceeds thereof," and stating that the L.C.C. regard the creation of a reserve or renewal fund as very desirable in the interests of prudent finance, and they will be glad to learn that steps will be taken to form such a fund. The Committee replied, agreeing to the Council's request.

L.C.C. and The Bulk Supply Bills.—At a meeting of the L.C.C. on Tuesday the adjourned report of the Parliamentary Committee, was considered in conjunction with a further report on the electric power Bills of the present session. In the first report the Committee asked the Council to approve its action in presenting petitions against the Bills, and in the second it sought authority to convene a conference at the County Hall on March 6th, of representatives of the City Corporation and of the borough councils. The Committee referred to the past action by the Council in the promotion of two electric supply Bills and to conferences held on the subject with representatives of the London local authorities. Having regard to these facts and to the number of local authorities affected by the Bills before Parliament, the Committee considered that a fresh conference should be held to discuss the proposals of the Administrative County of London and District Electric Power and the East London and Lower Thames Electric Power and other Bills. The Council would, in that case, have the advantage of knowing the views of the local authorities upon the legislative proposals. In the course of the discussion it was stated that three large companies were at present covering one-half of the area in London, and they had sufficient generating stations to supply one-half of London for the next 20 years. But there was another half—that occupied by the borough councils, which it might be possible for the County Council to step into. The Committee intended to meet the borough councils in order to see how they proposed to conduit their opposition and to inform them what the County Council had in contemplation. The recommendations of the Committee were then put to the meeting and were adopted, and it was decided to leave the date of the conference to the discretion of the Committee.

Liverpool.—Mr. A. B. Holmes, consulting electrical engineer to the Corporation, in reporting on the charges made for electrical energy in the city during the past year, says the result of the past year's business, if taken by itself, might appear to justify some reduction in the charges for electricity; but in view of additional capital charges in the current year, the estimated increase in interest and sinking fund by £6,045, and the material rise in the price of fuel, no general reduction in charges could be prudently made. But to encourage a more extensive use of electrical energy for power purposes, the price after 3,000 units per quarter should be reduced from 1½d. to 1d. per unit. Charges for electricity used for medical and other purposes, and not for lighting, should be made on the power scale.

Oldham.—The Tramways Committee has asked the Electricity Committee to reduce the price of energy, which is at present supplied for traction purposes at 1½d. per unit. When the price was fixed, the consumption was 1¼ million units per annum less than at present.

Ormskirk.—On February 28th the Ormskirk Urban District Council had before it the question of the adoption of an electric lighting scheme for the township, and it was ultimately decided that the scheme be proceeded with.

Macclesfield.—The B. of T. has requested the Corporation to send a deputation to meet representatives of Messrs. Foote and Milne, Ltd., at its office on the 7th inst. To this the Corporation has assented. A representative of Messrs. Preece & Cardew met the Electricity Committee recently in regard to a scheme for electrically lighting the borough; the initial cost being put at about £15,000.

Mansfield.—The T.C. has decided that from March 31st next the charges for energy shall be as follows:—For lighting, 7d. per unit, for any quantity of electrical energy used during each quarter, not exceeding the equivalent of 100 hours of supply at the maximum demand, and 1d. per unit for any quantity in excess; for power 4d. per unit, for any quantity used each quarter, not exceeding 100 hours, and 1d. per unit for any quantity in excess.

Petersfield.—The R.D.C. has decided that, as the gas company has given notice to terminate the contract for street lighting, it will advertise for tenders for the lighting of the streets by electricity or gas.

Pollockshaws.—The town clerk has received intimation that the Board of Trade has granted the T.C.'s application for an electric lighting order, with power to transfer it to the Corporation of Glasgow.

Shildon.—The U.D.C. has asked the Northern Counties Electricity Supply Co. to quote terms for the provision of a minimum of 25 lamps of 30 and 50 C.P. for public lighting, as an experiment.

South America.—The contract for the acquisition by the River Plate Electricity Co. of the rights of the La Plata Government in the E.L. undertaking at La Plata has been signed. The Province receives a balance of $89,000 m/n. The company intends to erect a new station, all the necessary plant for which has been ordered.—*Review of the River Plate.*

Stourport.—An unofficial canvass of the town, in support of permission being given by the U.D.C. to the Kidderminster Electric Lighting Co. to distribute energy in the town, is being made, and a committee has been formed to approach the U.D.C. on the matter.

Sunderland.—The Electricity and Lighting Committee has decided to recommend the T.C. to reduce the price of energy for lighting on the maximum demand scale, from 5d. for the first two hours and 2½d., to 4½d. and 2d.; for motors, from a flat rate of 2½d. per unit to 2¼d. for the first hour and 1¼d. afterwards; for power for the tramways, from 1⅞d. per unit to 1¾d. The year's estimates show a net profit of £4,000.

Swindon.—A L.G.B. inquiry was held on February 21st relative to the Corporation's application for a loan of £22,000 for electricity purposes. There was no opposition.

Tientsin. — A company has been formed to supply electrical energy within the municipal area and orders for the plant have been placed in Germany.

Torquay.—A meeting of the ratepayers was held last week to protest against the T.C.'s proposal to spend £42,000 on a new electricity works, and a postcard poll of the burgesses is to be taken regarding the matter.

West Ham.—At the meeting of the Corporation on Tuesday, it was reported that, in 1904, 278,714 units were sold for lighting purposes and 357,329 units for power, as against 254,654 units for lighting and 57,287 units for power in 1903. The borough treasurer, in his half-yearly report, stated: "The institution of deposit accounts has had a beneficial effect, and has been the means of safeguarding the undertaking to a considerable extent." The electrical engineer reported having been in negotiation with several companies supplying arc lamps, and had received from the Electrical Co., Charing Cross Road, the following proposal: "The company will supply and, if necessary, erect, together with the necessary wiring, flame or other arc lamps for consumers, subject to these conditions:—(1) Upon completion of the installation, 25 per cent. of the agreed cost to be paid, and the balance spread over two years by means of eight quarterly instalments; (2) In consideration of the Corporation collecting the quarterly payments, the Electricity Department to retain 10 per cent. of the gross amount collected; (3) In the event of a consumer discontinuing the supply before the expiration of the period of hire-purchase, the lamps to be returned to the company and the consumer to pay at least 50 per cent. of the cost of the lamp and the full cost of installing the same; (4) The company to reserve the right of refusing to supply lamps to any consumer." On the understanding that no responsibility attaches to the Council otherwise than as collectors, the terms were accepted, subject to a satisfactory agreement being entered into. The electrical engineer was authorised to negotiate on the same basis with the General Electric Co.

Willesden.—The solicitor of the U.D.C. reported at Tuesday's meeting that he had found it necessary to lodge a petition against the Metropolitan Electric Supply Co. (Acton District) Bill. This action was approved, and it was further resolved to take counsel's opinion as to the provisions of the Bill, in relation to the decision of Mr. Justice Farwell in the recent action of the Council against the company.

Wimbledon.—The U.D.C. on February 22nd decided to reduce the price of energy for public lighting from 2¾d. per unit to 2½d.

At the same meeting it was resolved to apply to the L.G.B. for a loan of £13,218 for additional plant and extensions at the electricity works.

TRAMWAY AND RAILWAY NOTES.

Barrhead.—A way out of the deadlock between the District Committee of Upper Renfrewshire and the Glasgow Corporation Tramways Committee in regard to the extension of the latter's system from Thornliebank to Barrhead, has been found. On Clause 82 of the Glasgow Tramway Order, which provides for the tramways being assessed at one-fourth of their value, being withdrawn, the District Committee agrees to the Corporation making the line a single one, with the stipulation that it is to be doubled within five years from the date of the Royal assent to the confirming act.

Birmingham.—A conference has taken place between the Birmingham Corporation and the King's Norton District Council with regard to through working of tramcars between the city and the suburbs of Moseley, King's Heath, Bournbrook, King's Norton, &c., which latter are in the boundaries of the District Council. Nothing is definitely known, but it is assumed that an amicable agreement has been arrived at.

The Small Heath—Yardley to Birmingham route is now working satisfactorily on the overhead system, the steam trams being superseded by electric on the 27th ult. The route is four miles, double track, in extent, and is supplied with energy at 500 to 550 volts from the Birmingham and Midland Tramways Co.'s generating station at Yardley. The station is equipped with four generating sets of equal size, each consisting of a Diesel oil engine of 160 H.P. direct coupled to an 8-pole Brush D.C. dynamo. The engines are of the two-cylinder vertical double-acting type fitted with extra heavy fly-wheels. The switchboard is of the usual type of Brush Co.'s make, having four dynamo, three feeder and one Board of Trade panel. There are also two 13-KW. motor boosters. The car-sheds are designed to shelter 30 cars. All the cars are fitted with Raworth's regenerative type of controller, and are of the four-wheeled pattern designed to carry 48 passengers. The fare for the whole distance is 2d.

Croydon.—The Croydon County Council, by 22 votes against 17, has decided to withdraw its Bill to extend the electric tramways to Upper Norwood and the Crystal Palace.

Greenock.—It is reported that the Greenock and Port Glasgow Tramway Co. has appealed to the High Court, London, against the decision of the Board of Trade, awarding the sum of £602 19s. 9d. as the proportion of profits due to the Corporation, and also ruling that the company is to account for two sums of £75, set aside for maintenance, and £1,500 placed to depreciation. The plea of the company is that the Board of Trade has no right to arbitrate in a matter of the kind.

Liverpool and Southport Railway.—On Friday morning (February 24th) a block occurred on the Liverpool—Southport Electric Railway which disorganised the traffic for some hours. A train of empty carriages was being drawn into Formby Station for the purpose of making up the 7.45 a.m. express from Formby to Manchester, when the last corridor coach left the points and blocked both up and down lines. Passengers had to alight at one side of the block and walk to another train on the other side to complete the journey. The electric current was switched off. By the block, confusion was caused at Southport, Birkdale, and Crossens. Much delay was occasioned, and instead of proceeding to Liverpool *via* Formby, the journey was made by way of Ormskirk.

London.—At the North Metropolitan Tramways Co.'s meeting on 22nd ult., Mr. George Richardson, who presided, said that overtures had been received from the London County Council, the result of the correspondence which had passed between the company and the Council, with regard to the proposed "electrification" of certain portions of the tramways worked by the company, but he had nothing definite yet to report to the shareholders on the matter. Their traffic had been adversely affected by the opening of the Great Northern and City Railway, but he could not see that they could be interfered with by the competition of any other company. There was no doubt that the time had come when the locomotion in the streets would be somewhat altered—he thought greatly altered—in favour of motor-omnibuses as against vehicles worked by horses. If the company could obtain a motor-car which could run on their rails they would be greatly benefited, but this was a question of time, and everything in connection with the subject would have to be watched by them with the closest attention. Mr. James Devonshire, a director, observed that a great deal had to be done by manufacturers and patentees, before a motor tramway would become practicable. For instance, a motor-car to run on the rails, in order to be a practicable machine, must be capable of being driven from both platforms. Their tramrails did not admit of a car being reversed, and they did not want to see a reversing table in the streets of London. He believed that in Paris most of the cars were turned round on a turn-table, much in the same way as locomotive engines were on the sidings of a railway, but it was obvious that this procedure would not be adopted in Paris if there were any practicable method for working the car from both ends.

Gorleston.—The arbitrator appointed by the B. of T. to fix the amount to be paid by the Yarmouth T.C. for the acquisition of the Southtown and Gorleston horse tramways, has given his award. The price at which the Council will take over the undertaking, track, cars, horses and depôt is £13,400, with the company's legal costs. The price asked by the company was £19,000.

Malta.—On February 23rd the Governor inaugurated the new electric tramway; Lady Clarke, the wife of the Governor, switched on the current. A party subsequently travelled from the power station at Marsa to Valetta in the cars.

Middlesex.—At the meeting of the County Council last week, it was reported that the net compensation paid up to date in respect of the light railways authorised by the 1901 order, was £97,382; and for those authorised by the 1903 order, £44,911. The result of the Light Railway Commissioners' recent inquiry was that the County Council's application for an Amendment and Lands Order (1904) in respect to the Waltham Cross and Enfield line was granted, subject to Railway No. 5 being withdrawn. A motion withdrawing the line (No. 5) was agreed to. The Light Railways and Tramways Committee recommended that an agreement be entered into with the Edmonton U.D.C. and the Metropolitan Electric Tramways, Ltd., for the reconstruction of tramways in the Edmonton district, and the widening of the Hertford main road. The consideration of the matter was adjourned.

New York Central.—This railway is about to be electrified over a radius extending to 40 miles from New York, at a cost of 50 million dollars.

North-Eastern Railway.—In view of the number of accidents which have occurred on the electric railways on which the third-rail system of traction is in operation, considerable interest is being taken in the prospective early opening of the light railway which the N.E.R. has constructed between Ponteland and Newcastle. The company originally intended to employ the "live-rail" system, but there now appears to be some doubt as to the system which will be employed. March 1st, was the date fixed for the opening of the line for goods traffic by steam haulage, but although an electric sub-station has been erected at Kenton, no power rail has yet been laid down. In the neighbourhood it is stated that the company is considering whether the overhead system could not be advantageously used.

Singapore.—An Indian exchange says that the electric tramways are expected to be running during the current month.

Southport and the Liverpool Overhead Railway.—The junction line between the Seaforth Sands station of the Overhead Railway at Liverpool, and the Lancashire and Yorkshire Railway, has been completed, and everything is in readiness for the new through service to be commenced. Passengers will be able to travel from Southport or any intermediate station to the stations on the Overhead Railway system. A great advantage offered is that persons living in the South-end, and wishing to go to Southport, can travel direct from the Dingle, avoiding intermediate changes.

The Underground Railway.—At one o'clock on Tuesday morning an electrically propelled train ran to Aldgate Station, on the Metropolitan Railway, from Neasden. The company expect to be ready to run their electrical trains in three weeks.

Warwick.—The electrification of the tramways on the overhead system is to be proceeded with forthwith by the Leamington and Warwick Electrical Co.

West Bromwich.—It is the intention of Councillor Baggott to move a resolution at the next meeting, authorising the Corporation to take proceedings against the tramway company, whose lines run through the borough, to enforce the terms of agreements and leases as to the alleged curtailing of the tramcar service.

TELEGRAPH AND TELEPHONE NOTES.

Glasgow Telephones.—It is interesting to note that the National Telephone Co. has now 20,000 telephones on rental working in the Glasgow district. The net increase for last week amounted to 215 telephones, which is a record. The company has during the past month opened four new exchanges in this district, thus bringing a number of outlying villages into touch with the city.

Russian Telegraphs.—The *Standard* St. Petersburg correspondent states that orders have been issued to establish a direct telegraph line between St. Petersburg and Vladivostok.

Telephone Trunk Charges.—In reply to a question in the House of Commons on Tuesday, Lord Stanley said that the average payment for a conversation over the telephone trunk system of the United Kingdom was less than 6d., and, having regard to the cost of the trunk lines and to the difficult conditions to which the construction of those lines was subject in this country, he was not prepared to recommend any reduction in the present scale of charges. New trunk lines were filled with traffic almost as soon as they were opened, and it was difficult to keep pace with the demand for increased facilities, even at the present rates. In the United States the charges for the same distances were much higher than in this country.

Brighton Telephones.—The Telephones Committee has received the following report from the engineer and manager, with reference to expenditure in excess of the provisions made in Mr. Bennett's estimate, and also with reference to the estimated cost of providing additional ducts and cables in the Borough of Hove, which are urgently needed to meet the requirements of subscribers there:—"I have to report that the following additional work, sanctioned by the Council on April 7th, 1904, has been done in excess of what was intended in Mr. Bennett's estimate:—

Extension of ducts in Preston Road and Upper Lewes Road..	£1,195 0 0
Extensions of cable, and laying same	3,013 5 6
Building switchroom; Mr. Bennett allowed £550 for adapting a room to exchange requirements, but did not anticipate that such extensive alterations would be necessary. The cost has been £1,137 16s. 2d. Difference	587 16 2
Power room	94 7 1
Power plant	99 10 0
Cables and ducts beyond Claremont Road in Patcham Parish	216 12 6
Cable and ducts in Portslade	80 0 0
Cable at Southwick and Kingston	60 18 2
Ducts laid by Hove Corporation in Church Road, Hove, and now used by this department	394 2 3
Difference in cost of switchboard between original tender and actual cost, owing to order being given first for 1,000 lines, and afterwards extended to 2,000 lines	525 0 0
	£6,216 11 8

I, therefore, recommend that you apply to the Local Government Board for sanction to a loan to defray the cost of the extension of the ducts and cable, amounting to £4,208 5s. 6d., and also £2,008 6s. 2d., the cost of the other works enumerated above. You have at the present time 1,687 instruments working, and 22 junction lines, making a total of 1,709 completed lines. In addition you have 1,229 partially completed lines, making a total of 2,938 completed and partially completed lines. I have also to report that in the Borough of Hove, 259 lines have been provided, and you have 186 instruments working on these lines. There are a number of others in Hove working on the Brighton cables. There is now such a small number of spares that it is imperative that you should supplement the underground cables in Hove at once, and in every direction. I have prepared a scheme to provide 312 additional lines in Hove. The cost I estimate will be £5,399 11s. 5d. I, therefore, recommend you to apply to the Local Government Board for sanction to a loan of £5,400 to defray the cost of these extensions. I am pleased to be able to say, that although you have not yet got the 2,000 lines working on which your revenue was estimated to yield a profit, the net profit, after allowing for sinking fund and interest on the money borrowed, and all other charges is now at the rate of £80 per month, and every month it is increasing. The profits thus earned will enable the Council to establish a substantial reserve fund."

Telegraphic Interruptions and Repairs:—

Cables,	Interrupted,	Repaired,
Trinidad-Demerara (No. 1)	Aug. 26, 1901 ..	..
Dominica-Martinique	May 7, 1902 ..	..
St. Lucia-Martinique	May 7, 1902 ..	..
Cayenne-Pinheiro	Aug. 13, 1902 ..	..
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902 ..	..
Tarifa-Tangier	Jan. 18, 1904 ..	..
Closed { Vladivostok-Nagasaki	Feb. 9, 1904 ..	..
{ Port Arthur-Chifu	Mar. 9, 1904 ..	..
Paramaribo-Cayenne	July 13, 1904 ..	Feb. 24, 1905
" "	Feb. 25th, 1905	
Jamaica-Colon	Jan. 5, 1905 ..	..
Marmaritza-Rhodes	Jan. 30, 1905 ..	..
Martinique-Paramaribo	Feb. 14, 1905 ..	Feb. 24, 1905
Guernsey-England	Feb. 28, 1905 ..	..
Gibraltar-Tangier	Feb. 20, 1905 ..	..
Oran-Tangier	Feb. 24, 1905 ..	..
Para-Maranham	Feb. 24, 1905 ..	Feb. 28, 1905
Para-Pernambuco	Feb. 24, 1905 ..	Feb. 27, 1905
Landlines.		
Puerto-Barrios	July 28, 1902 ..	..
Kertch-Soutchoum	Sept. 27, 1904 ..	..
Rome-Pera	Jan. 27, 1905 ..	..
Bhamo route beyond Tali	Jan. 15, 1905 ..	..
Newfoundland—all places in the interior	Feb. 10, 1905 ..	..
Fao route beyond Bassora	Feb. 13, 1905 ..	Feb. 28, 1905

Telegraphy in the Far East.—The scheme for the establishment of a new cable in the Far East, which is intended to form a connection independent of English lines, as from the island of Java to the new business cable in those parts, has not yet made much progress in the hands of the German-Dutch syndicate which has been subsidised by both Governments. According to the agreement signed at Berlin in 1901, the cable was to be laid *vid* the Pelew Islands, but it has now been ascertained that not one of the islands is suitable for the purpose. It will therefore be necessary to direct the cable *vid* Yab Island, which lies 275 miles further towards the east. The German Government has already agreed to the deviation, and the adhesion of the Dutch Government is also expected shortly.

The Murray Printing Telegraph.—The German telegraph authorities, who have for several years past made experiments with the Murray automatic printing telegraph, recently introduced the method in practical working, between Berlin and Emden, a distance of 291 miles. The results have been satisfactory, a maximum performance of 120 words a minute having been accomplished in single working. As a consequence, the Murray apparatus is to be adopted for some lines connecting important towns, and the cities of Berlin and Hamburg have been selected as a beginning.

Wireless Telegraphy.—We have received some particulars of the business transacted by the Gesellschaft für Drahtlose Telegraphie m.b.H., Berlin, from December 15th, 1904, to January 15th, 1905. This company is working the Slaby-Arco and Braun-Siemens wireless telegraph systems combined. In *Argentina* the following installations have been erected and put in

operation:—Recalada—Fireship (R.C.) near Buenos Ayres; Rio de Santiago (R.S.); Buenos Ayres Government Buildings (B.A.); and installations for the ships *Julio* and *Patria* have been put in hand.

Belgium.—At the request of the War Minister, two portable installations have been sent to Belgium for trial purposes.

Brazil.—Installations for the ironclad *Riachuelo* and for the *Ilha das Cobras* (Rio) have been put in hand.

Denmark. — The installations ordered last year for Gjedner Harbour and Gjedner Lightship will shortly be installed. In addition to these, stations for the ironclad *Olfert Fischer* and the cruiser *Geyser* will be erected.

Germany.—The application of wireless telegraphy in the army is progressing with rapid strides, and it is intended to equip a number of fortresses with stations. Two trial installations have been put in hand, and have already been delivered. The question of the erection of two installations for the Imperial Post Office is now being considered, which installations will be utilised for instructing the staff. The Navy has placed an order for one installation for the pilot ship *Jade* and seven installations for warships.

The company has erected several trial apparatus for demonstration purposes, which give a comprehensive idea of the necessary connections, and are specially suitable for use in schools.

Ecuador.—The Government has decided to erect installations in Guayaquil and Puna, and intends placing further orders with the company.

Holland.—Four installations have been ordered for the instruction of the telegraph staff. The installation owned by the Telegraph Administration in Scheveningen has been rebuilt for a distance of 400 km., and placed at the service of the Post Office. Two ship installations have been sent to the Dutch Indies, where they will be tested to prove their adaptability to the climate.

Peru.—The apparatus for the stations ordered by the Government for Puerto Bermudez and Massisea (200 km. distance from Puerto Bermudez) are now completed. Two engineers and a fitter were to leave with the installations in the early part of February.

Russia.—The company has the erection of 11 installations in hand. Orders have been placed for 26 ship installations.

Spain.—Two installations have just been erected at La Coruna and Ferrol.

Turkey.—The installations ordered by the Sultan for Rodos and Derna (N. Africa) are so far advanced that an engineer has been sent out to prepare for the erection.

Uruguay.—The large installations, for communication with ships of the Hamburg-South American line, in Monte Video have been completed.

The company, which, it will be remembered, was founded jointly by the A.E.G. and Messrs. Siemens & Halske, has issued, in English, a fully illustrated brochure showing what has been done with the system, since the two systems were combined.

Wireless Telegraphy.—The *Daily Telegraph* correspondent states, that the wireless telegraphy station at Scheveningen is open for private messages, and is being extended so as to make communication with the whole East Coast of England possible. The commander of the *Hohenzollern* communicated, with good results, with the Kaiser *vid* this station on the 24th ult.

The Marconi Co. has decided to issue a telegraphic code of its own, which will be available to the public on all ships and at offices fitted with its system. A list of telegraphic addresses and of people using the code will be issued with it at the cost of one guinea inclusive.

A *Daily Mail* dispatch from New York says that Lieut. Robert Peary will start for the North Pole on July 15th, and that, for the first time in Arctic exploration, wireless telegraphy will be used.

Telegraphs in French Indo-China.—It is stated in the Report on Telegraphs in French Indo-China for 1903 and 1904 (*Journal Télégraphique*) that the cables have not given complete satisfaction. The Tourane-Amoy cable, which was interrupted from November, 1902, until April, 1903, gave out again in November of the same year, and was not restored till April, 1904, owing, it is said, to bad weather. The Tonkin cable was interrupted from December 31st, 1902, till January 22nd, 1903; April 16th—May 5th, 1903; June 7th—June 21st, 1903; September 28th—October 7th, 1903; and December 11th, 1903—January 11th, 1904. This cable is to be relaid and landed at Tourane. Wooden poles are being replaced by iron ones, 3,832 of which were erected during 1903, and these are also being used in the construction of new lines. Relays have been established at Vinh, Tourane and Nhatrang, thus establishing direct communication between Saigon and Hanoi (1,662 kilometres) by the Hughes apparatus. Offices have been opened at Roon, Vinhtuy, Léthuy, Tayhoa, Phu-Lé and Banghoi, thus facilitating repairs of very frequent interruptions, especially in the South, where elephants have caused enormous damage. During 1903, international telegrams numbered 76,491, and during the first six months of 1904 they were 44,389.

Lighthouses.—During last year to March, £3,847 was spent out of the General Lighthouse Fund for establishing electric communication with lighthouses and light-vessels.

The Telephone Agreement.—The *Times* says that it has been arranged, that the Select Committee about to be appointed to consider the agreement between the Postmaster-General and the National Telephone Co., and to report whether it is desirable in the public interest that the agreement should become binding, shall consist of Mr. Beckett, Sir Horatio Davies, Mr. Helme, Sir William Holland, Mr. J. Nolan, Sir Charles Renshaw, and Mr. Stuart Wortley.

CONTRACTS OPEN AND CLOSED.

OPEN.

Bray.—March 20th. Electrical supplies for the U.D.C. See "Official Notices" to-day.

Bolton.—March 30th. Cooling tower and condensing apparatus. See "Official Notices" to-day.

Burton-on-Trent.—March 14th. 100-KW. C.C. tramway generator for coupling to existing steam plant. See "Official Notices" to-day.

Darlington.—March 20th. Tenders are required for a supply of motors on the hire-purchase system to consumers. See "Official Notices" to-day.

Edinburgh.—March 13th. Carbons, meters, boxes, troughing and bitumen for the Electricity Supply Department. See "Official Notices" February 24th.

Gravesend.—March 14th. Engine room stores, oil, lamps, carbons, meters and indicators, cable troughing, &c. See "Official Notices" to-day.

Great Central Railway.—March 7th. The company is prepared to receive tenders for the supply, during the twelve months ending April 30th, 1906, of various stores and materials including asbestos, &c., packing; electric light materials; telegraph materials. Mr. A. W. Longden, the storekeeper, at Cornwall Street, Openshaw (near Gorton Station).

G. W. Railway.—March 13th. Plant (three-phase and direct current) for the proposed sub-stations and distributing centres in connection with the Park Royal generating station. See "Official Notices" February 10th.

Gloucester.—March 16th. Boilers, 600-KW. generator, condensing plant, piping, feed pump, &c., for electricity supply extensions. See "Official Notices" February 24th.

Hoylake and West Kirby.—March 21st. One 250-KW. steam alternator, piping, &c. See "Official Notices" to-day.

Italy.—April 3rd. Tenders are being invited until April 3rd, by the Municipal Authorities of Castrorillari, for the establishment of a central station for the public and private electric lighting of the town. Particulars may be obtained from, and tenders are to be sent to, El Consiglio Comunale di Castrorillari.

Johannesburg.—March 6th. 100 electric cars, two electric water cars, five-ton crane, car traverser, and workshop tools, for the Municipal Council. See "Official Notices" December 30th.

Johannesburg.—March 13th. Arc lamps and lanterns. See "Official Notices" to-day.

Keighley.—March 27th. Lancashire boiler and steam dynamo. See "Official Notices" to-day.

Leeds.—March 14th. Rotary converters, transformers, and switchboards for two sub-stations. See "Official Notices" February 24th.

Lowestoft.—March 9th. One water-tube boiler with superheater, brickwork and accessories, and pipework. See "Official Notices" February 17th.

Manchester.—March 6th. Stores, &c., for the Tramways Department. See "Official Notices" February 24th.

Newport (Mon).—March 6th. 300-KW. continuous current tramway generator; 200-KW. continuous current steam balancer; one (straight tube) water-tube boiler and superheater; marble switchboard; extension of switchboard gallery; general stores including lamps, carbons, engine room stores and electrical stores &c. See "Official Notices" February 17th.

Porto (Portugal).—March 15th. The Town Council has opened a competition for the concession for the exclusive right of working the tramways for the collective transport of passengers, luggage, and goods in all the municipal public ways. The conditions of the competition are published at the Portuguese Consulate in London.

Salford.—March 4th. Alterations to batteries. See "Official Notices" February 17th.

Shanghai.—March 31st. Construction and working of 24 miles of electric tramways on the trolley system, double or single. See "Official Notices" October 14th.

South Shields.—March 13th. Boiler, two vertical engines and 550-KW. traction generators, and traction switchboard for the Corporation. See "Official Notices" February 10th.

Spain.—March 12th. The Municipal Authorities of Javea (province of Alicante) are inviting tenders until the 12th inst. for the concession for the electric lighting of the town. Tenders are to be sent to El Secretario del Ayuntamiento de Javea (Alicante) whence particulars may be obtained.

Swindon.—March 21st. Lamps, cables, oils, D.C. meters, boxes and feeder pillars. See "Official Notices" to-day.

Wimbledon.—March 4th. Stores for the electricity department. See "Official Notices" February 10th.

Wrexham.—March 10th. Supplies for the Electricity Department. See "Official Notices" February 24th.

CLOSED.

Belgium.—Eight tenders were sent in for the supply of 15 electric cranes for the harbour, on account of the municipal authorities of Ghent, the lowest being that of the Société des Ateliers de Constructions Electriques, of Charleroi, which quoted £640 for each crane.

Belmont Asylum.—Messrs. Bromley & Batstone have placed the order for the underground cables and boxes with Messrs. Johnson & Phillips, Old Charlton.

Birmingham.—Tenders have now been received for the switchgear necessary for the new scheme of trams and lighting, but nothing has as yet been settled.

Brighton.—The following tenders have been received in reply to invitations for estimates for the supply and laying of the necessary cables for supplying Aldrington from the Southwick power station :—

Western Electric Co.	£2,194
Siemens Bros. & Co.	2,850
St. Helens Cable Co.	2,427
W. T. Henley & Co.	2,465

Mr. A. Wright recommends the Council to accept the tender of Messrs. Siemens Bros. & Co., on the ground that it is very desirable to have only one contractor to carry out the trench work in Southwick and Portslade.

Derby.—The T.C. has accepted the tender of the Sunbeam Lamp Co. Ltd., for the supply of incandescent lamps to the E.L. Committee for the ensuing year.

Fulham.—The B.C. has accepted the tender of the Universal Engineering Co. Ltd., at £2,157 10s., for the construction of the brick chimney shaft at the electricity works.

Islington.—The B.C. has accepted the tenders of the following for annual supplies of meters, time switches, carbons, incandescent lamps, terminal boxes, arc lamp globes and general stores and sundries required for the electric light undertaking:—The Sloane Electrical Co., Messrs. Rumney & Rumney, Jas. Gibbs and Co. Ltd., Wilcox & Co. Ltd., Witty & Wyatt Ltd., Pryke & Palmer, Doulton & Co., Alex. Duckham, and the Albion Clay Co.

Leith.—The Electric Lighting Committee on 23rd ult. had before them tenders for the dynamo, boiler and switchboard. There were 83 tenders for the dynamo, and the Committee made a selection, which, however, is subject to an arrangement. The contract for the boiler, for which there were 66 tenders, was placed with Messrs. Babcock & Wilcox, whose price is £2,287. For the switchboard there were 26 offers, which were left in the hands of the sub-committee with powers.

Poplar.—With regard to the notice in our last issue respecting the tenders for boilers, we are informed that the matter has been referred back to the Committee for furthur consideration.

Lancaster.—The T.C. has accepted the tender of the British Westinghouse Co., Ltd., for the supply of two tramcars, at £570 each.

Stepney.—The B.C. has accepted, in connection with the erection of the second half of the electric light station, the tender of Messrs. Jessop & Appleby, at £150, for the supply of an electrically driven wall jib crane.

Sunderland.—The Electricity and Lighting Committee of the T.C. has accepted the tender of the Electrical Co., Ltd., for the supply of switchboard panels for the sub-stations at schedule prices, less 10 per cent.

West Ham.—The Corporation has accepted the following tenders for annual supplies :—

Cable, British Insulated & Helsby Cables, Ltd.
Integrating wattmeters, British Thomson-Houston Co.
House cut-out boxes, British Insulated & Helsby Cables, Ltd.
Transformers, British Westinghouse Co.
Stores, Wiggins & Rihll.
For six months' supply of coal (Mardy slack), the tender of Foster & Co. was accepted.

No tender was accepted for incandescent lamps, the electrical engineer being authorised to purchase same from time to time on the best terms.

The Recent Submarine Disaster.—The Admiralty inquiry into the cause of the explosions in submarine A 5 in Cork Harbour on February 16th, was concluded on the 23rd ult. Capt. R. H. S. Bacon, naval assistant to the First Sea Lord, in summing up the evidence, stated :—"I find that the explosion in A 5 submarine was caused by the presence in the boat of petrol vapour from a leak of liquid petrol at the badly-packed gland of the petrol pump, and that the explosive mixture formed was ignited by sparks from the main motor brushes caused by attempting to move the motors electrically with a view to revolving the engine; and, further, that such a use of the motor was in flagrant violation of the regulations laid down." From the evidence it appears that the whole of the electrical apparatus, switches, lights, fuses, &c., are in air-tight cases, with the exception of the motor brushes, but the enclosing of these was apparently not favoured.

FORTHCOMING EVENTS.

To-day's Arrangements.—At 8 p.m. Junior Institution of Engineers. "Possible Improvements in Locomotive Practice," by Mr. W. Longland.
At 9 p.m. Royal Institution. "Recent Advances in Wireless Telegraphy," by Mr. G. Marconi.
At 7.30 p.m. N.E. Coast Institution of Engineers. Consideration of present Board of Trade Regulations for Certificated Marine Engineers.
At the Hotel Metropole, Leeds. Annual dinner of the Leeds Section of the Institution of Electrical Engineers.

Saturday, March 4th.—At 7.30 p.m. Glasgow Technical College Scientific Society. "Steam Generators and their Failures," by Mr. G. Nees.
Monday, March 6th.—At 7.30 p.m. Society of Engineers. "The Transport Possibilities of our Inland Navigable Waterways," by Mr. B. H. Thwaite.
At 7.50 p.m. Faraday Society. At the Library of the I.E.E. Annual general meeting. At 8.15, Paper by Mr. F. W. Harbord on "Recent Developments in Electric Smelting in Connection with Iron and Steel."
At 8 p.m. Society of Arts. "Internal Combustion Engines," by Mr. Dugald Clerk. (Lecture IV.)
Tuesday, March 7th.—At 8 p.m. Institution of Civil Engineers. Further discussion on "Surface-Condensing Plants, and the Value of the Vacuum Produced," by Richard W. Allen.
Wednesday, March 8th.—At 8 p.m. Association of Engineers-in-Charge. "Water Softening," by Mr. J. J. Lassen.
Thursday, March 9th.—At 8 p.m. Institution of Electrical Engineers. Report on Experiments carried out at the National Physical Laboratory:—"On the Effect of Heat on the Electrical and Mechanical Properties of Dielectrics," and "On the Temperature Distribution in the Interior of Field Coils," presented by Dr. R. T. Glazebrook, F.R.S.
Mr. R. Goldschmidt, "On Temperature Curves and the Rating of Electrical Machinery."
Friday, March 10th.—At 6.45 for 7 p.m. I.E.E. (Manchester). Annual Dinner at the Midland Hotel.
At 8 p.m. Physical Society. "On Direct Reading Resistance Thermometers, with an Appendix on Composite Thermocouples," by Mr. A. Campbell; and other papers.
At 9 p.m. Royal Institution. Prof. J. J. Thomson, on "The Structure of the Atom."
Saturday, March 11th.—At 3 p.m. Royal Institution. Prof. J. J. Thomson, on "Electrical Properties of Radioactive Substances." (Lecture I.)
At 3 p.m. Junior Institution of Engineers. Visit to new Ritz Hotel, Piccadilly, to inspect the "Cage Skeleton System of Constructional Engineering."
At Birmingham. Birmingham and District Electric Club. Mr. E. C. R. Marks, on "Electric Lifting Machinery."

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders have been issued for next week :—

Monday, March 6.—"A" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Lecture on the "Steam Engine," with practical demonstrations, by Captain Phillips, 7 p.m.
Tuesday, March 7.—"B" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Medical inspection for recruits and Special Service Section, 7 p.m. Lecture on "Portable Daimler Oil Engine," by Captain Phillips.
Wednesday, March 8.—Submarine mining class, 6—9 p.m. Examination "A" and "B" Companies for "A" badge, 7.30 p.m. Instruction in "Stoking Steam Engine," by Lieut. Bunn, 7.30 p.m.
Thursday, March 9.—"C" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Lecture on "Cordite and High Explosives," illustrated by experiments and lantern slides, by Sapper Caldwell.
Friday, March 10.—"D" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m.
Saturday, March 11.—"A" Company to furnish detachments for combined operations at Uxbridge with 2nd Middlesex and London Scottish Volunteers.

J. H. S. Phillips, Captain,
For O.C.E.E.R.E. (V.)

NOTES.

Jandus Arc Lamp Case.—Subsequent to the reading of the judgement in this case, printed on pp. 346-7 of this issue, his Lordship granted a certificate that the plaintiffs' patent had been in question, and a certificate of breaches. Stay of operation of the injunction pending appeal was refused, his Lordship saying that he hoped the parties would make some arrangement to enable the defendants to carry on their business in the interim.

Municipal Tramways Association.—The managers' section of the Municipal Tramways Association met in Birmingham on 24th ult. under the presidency of Mr. Baker, tramway manager to the Birmingham Corporation. They were welcomed by Alderman Beale, chairman of the Tramways Committee. Mr. J. M. McElroy gave a paper on "Overhead Equipment," and Mr. Baker one on "Tramway Telephones." Discussion followed, and after lunch a visit was made to the Yardley power house of the tramway company.

On Tuesday in London a conference of the Municipal Tramways Association was held for the purpose of considering the proposals of several railway companies to establish motor-'buses in connection with their railways. Councillor Boyle, chairman of the Manchester Corporation Tramways Committee, presided, and about 10 authorities were represented. The conference framed a clause which provided for the limitation of the service of motor-'buses to routes between the companies' railway stations and fixed points outside. The conference considered also the question of the erection of guard-wires where telegraph or telephone wires are carried over existing tramways, expressing objection to municipal and company tramway promoters being compelled to provide the funds in such cases. The Board of Trade is to be asked to receive a deputation.

Appointments Vacant.—First assistant electrical engineer for Wakefield (£150); depôt foreman for Exeter tramways.

Temporary Tramway Tracks.—At the L.C.C. meeting on Tuesday, the Highways Committee presented a report referring to the recent action in the High Court by omnibus proprietors against the Council's contractors for the reconstruction of a portion of the Greenwich tramways, and in which the authority of the Council to place raised temporary tracks on the surface of the road had been questioned. In that case, judgement was given in favour of the plaintiffs, but a stay of execution was granted with a view to an appeal. The Committee stated that the matter was of such importance that, to safeguard the position of the Council, it would be wise to seek express statutory authority in the Council's Tramways Bill now before Parliament to lay down raised temporary tramway tracks, and to maintain car services thereon during reconstruction, and the Committee made a recommendation in this direction.

Telephone Exchange Fire.—Shortly after 2 a.m. on Tuesday a serious fire occurred at the National Telephone Co.'s exchange in Salter's Hall Court, Queen Victoria Street, E.C. The *Daily Chronicle*, in its report of the occurrence, says that the cables of the company run through the tunnel of the District Railway, which passes under Salter's Hall Court. On Monday night the railway company were trying the new electric installation, and a strong current was passing through the conductor rail. It is thought that, from some unexplained reason, a short circuit between the rail and the telephone cable was brought about. The current is then supposed to have got on the telephone wires in the test rooms at both the Oxford Court and Bank exchanges, and thus caused the fire. The flames quickly involved a number of wires which were suspended from a mass of ironwork over Mansion House Chambers. These wires soon became "live" with a vengeance, and huge cables began to snap and fall about in Queen Victoria Street, and the surrounding thoroughfares, and some upon the roofs of buildings near. Captain Hamilton, the chief officer, and Mr. S. G. Gamble, his second in command, were present. The chief danger arose from the falling telephone wires, and from glass falling. Mr. Gamble was cut rather badly about the hand from this latter cause. The fire caused the whole of the 5,000 subscribers at the Bank exchange to be disconnected. It was hoped that in a few days everything would be put right.

Electricity in Mines.—The Home Office is sending out to mine-owners a notice of proposal, under Sec. 54 of the Coal Mines Regulation Act, 1887, of new special rules regulating the installation and use of electricity in mines. The rules, a copy of which accompanies the notice, are based on the recommendations contained in the report of the Departmental Committee on the Use of Electricity in Mines, and they have been agreed upon in their present form between the Secretary of State and the Mining Association of Great Britain. A number of the detailed rules suggested by the Committee as to the construction, &c., of electrical apparatus have been omitted. It is proposed to embody these recommendations of the Committee in a memorandum which will call attention generally to the points to be attended to in the erection of plant. This will be issued to colliery-owners subsequently. The rules as to shot-firing recommended by the Committee have also been omitted (with the exception of two), as being out of place in the present code. The question of the adoption of the Committee's recommendations on this point will be considered separately.—*Times.*

Institution Notes.—At the meeting of the North-East Coast Institution of Engineers and Shipbuilders held at Newcastle-on-Tyne on the 24th ult., Mr. J. F. C. Snell, M.Inst C.E. (electrical engineer to the Sunderland Corporation), read a paper on "The Application of Electricity to Industrial Purposes." He said that many papers had been read on that subject in recent years, yet the present one might be excused owing to the increasing use of electricity as an agent in the transmission of energy and in its application to the driving of machines in shipyards, engine-works, collieries, &c. There were at least two important points which had to be constantly dealt with in this district, and upon which there was still a great divergence of opinion. These were (1) the comparative economy between installations (for the driving of machine tools) laid down at the works themselves, and the purchase of electricity from an outside power station owned either by a separate company or by the municipality; and (2) the comparative advantages of direct current and alternating polyphase currents. As the subject would be treated with particular reference to the North-East Coast, only three-phase alternating currents would be considered. Further, he wished to make clear two other matters which were of great importance to the management of these works—their position electrically to the Board of Trade and the Home Office, and the importance and economy of standardisation. It was hoped that a clear understanding would be arrived at as to the relation of independent electrical generating plant *versus* the purchase from a public source of supply. He was able to record the actual results of electrical stations owned by two large shipyards, one of which was being partly driven by its own steam-driven plant and partly from a town supply, these two systems being entirely separated from one another. The other example was that of a shipyard supplied from its own gas engine-driven generating plant. From these two examples it was seen that there was a variation in cost per unit from separately driven plant of respectable dimensions of from 1·08d. to 1·173d. He always contended that in works requiring from 300,000 to, say, 1,000,000 units per annum, and with a load factor of 20 to 30 per cent., the cost would be found to vary from 1·25d. per unit to 1d., and he was of opinion that, looking at the question broadly, and taking into account an adequate depreciation of plant and average cost of upkeep for, say, a period of 20 years, 1d. was about the lowest limit for installations of the size stated. He was aware, of course, that there were special occasions in which, either through an abnormal and excellent load factor or through the utilisation of blast furnace gases the cost was materially reduced below this figure. These were, however, quite the exceptions, and he affirmed, without fear of contradiction, that the generality of installations would be found to have costs within the limits cited. After giving various comparisons and diagrams, Mr. Snell said they showed that the higher the load factor of a particular installation, the less reason there was for the purchase of power from an outside company, and the more excuse for installing one's own plant, and that at a load factor of 50 per cent. the costs were identical, and that for load factors above 50 per cent. the power could be more economically generated on the spot; but as this only applied to exceptional plants, such as pumping or paper mills working constantly, and did not apply to engine-works and shipyards having a load factor of under 40 per cent., the inference was that the greater number of works in the district would benefit from co-operation by becoming consumers of one general power supply. The reader of the paper then referred to the comparative advantages of direct current and alternating polyphase currents, and also directed the attention of electricity users to their position with respect to the Board of Trade and the Home Office, and also to the advantages of standardisation in the grouping of machinery and tools to the respective sizes of motors. The author was confident that transmission in the future in workshops and other factories would be almost entirely by electrical means, and one important point he would ask users to remember was the quicker rate of doing work which frequently resulted from the adoption of electricity. He would ask manufacturers to look at the cost of their power squarely. There were too many instances of such figures as ½d. per H.P.-hour or less being given, which when analysed were soon proved to contain merely the cost of fuel and stores, not the whole of the wages, and only a vague idea of the repairs, with no provision for depreciation of plant, rating, interest on capital outlay, or general superintendance. He knew in many works it was difficult to arrive at a true assessment of some of these figures. That they had entered an era of almost universal adoption of electricity he was quite certain. At the same time manufacturers should not hastily adopt the new method, but should take time in laying out their works to the most economical advantage. Discussion ensued, and the meeting adjourned.

At a meeting of the Royal Society yesterday, the following papers were down to be read:—

Hon. R. J. Strutt, "On the Radio-Active Minerals"; communicated by Lord Rayleigh. Mr. G. C. Simpson, "Atmospheric Electricity in High Latitudes"; communicated by Prof. A. Schuster. Mr. G. W. Walker, "On the Electric Resistance to the Motion of a Charged Sphere in Free Space, or in a Field of Force"; communicated by Prof. A. E. H. Love.

The annual dinner of the Leeds Local Section of the Institution of Electrical Engineers will be held at the Hotel Metropole, Leeds, this evening.

Before the Tramways and Light Railways Association on 23rd ult., Mr. Herbert Jones read a paper on the working results of the Waterloo and City Railway. In the discussion which followed the reading of the paper, Mr. Jones expressed the opinion that one of the rules of the Board of Trade which required that no main cables should be placed throughout the train and that no motor should be put in the middle of it, would have to be altered.

On February 28th, before the Institution of Civil Engineers, a paper was read on "Surface-Condensing Plants, and the Value of the Vacuum Produced," by Mr. R. W. Allen, A.M.I.C.E.

Association of Electric Power Companies.—Application has been made to the Board of Trade for a licence directing an association about to be formed under the name of the Incorporated Association of Electric Power Companies, to be registered with limited liability without the addition of the word "limited" to its name. The association is intended to encourage, expedite and facilitate the development of the industry of supplying electrical energy for power and light and other purposes, and to advance, watch over and protect the interests and further the objects of companies or persons possessed of Electrical Power Supply Acts, and to take such action as may be lawful or expedient for the advancement or protection of the interests and objects of undertakers, the association or members thereof, or to secure such development of the industry. A full list of the objects of the association appeared in the *Times* on February 23rd.

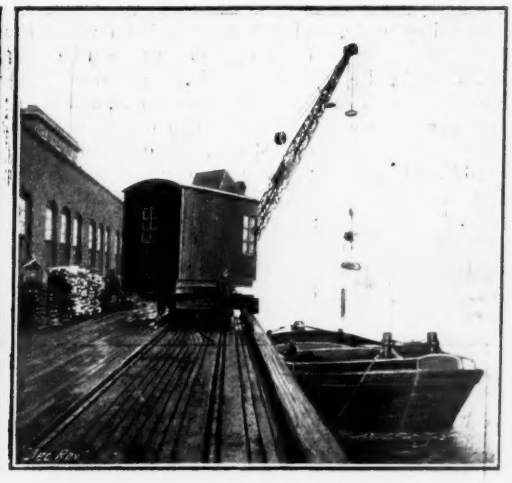
Train Lighting.—The Gesellschaft fur Elektrische Zugbeleuchtung is the title of a new company which has been formed in Berlin with a share capital of £50,000, of which one-third each has been been subscribed by the Allgemeine Electricity Co., the Siemens-Schuckert Works Co. and the Accumulator Works Co., of Berlin and Hagen. The object of the company is the construction and supply of electric lighting equipment for trains, both in Germany and abroad, and according to a system which has already found considerable application in the D trains on the Prussian State railways.

Erratum.—The St. Helens Cable Co., Ltd., are anxious to let it be known that the omission of the last letter R in the word "Retrograde," which appeared in the company's advertisement last week, was through no error of their own. Our advertisement department never had any intention of fastening this printers' slip upon our correspondents, and we are sure our readers attributed the fault to the only possible cause.

THE WESTERN ELECTRIC CO.'S FACTORY, NORTH WOOLWICH.

We recently visited the factory of the Western Electric Company at Woolwich, and obtained particulars of the extensive changes which have taken place in their organisation and equipment. The site of the works covers an area of 4½ acres, and it is of interest to record that it forms a part of one of the oldest cable manufacturing sites in the United Kingdom, and therefore, of course, in the world; it was here that the Persian Gulf cable was made, Atlantic cables were armoured, and numerous others were manufactured. The site was acquired by the Fowler-Waring Cables Co., who started upon it the first manufacture of lead-covered cable in this country; later on, the Western Electric Co. purchased the business of the Fowler-Waring Co. as a going concern, and took over the works in the commencement of 1898. Important alterations in buildings and plant were immediately undertaken, but a disastrous fire in July, 1899, destroyed the main building, and all the insulating and stranding machinery. Temporary arrangements were made for continuing the manufacture pending the rebuilding, which was done on the same ground plan. In order, however, to make provision for additional manufactures, and to utilise the site to the best advantage, as well as to ensure the most perfect and economical manufacturing conditions, the factory has quite recently been entirely redesigned and, to a great extent, rebuilt. So far as the cable department is concerned, the reconstruction is now almost complete. Considerable additions are in progress, or in preparation, for the instrument department of the company, but the present description is limited to the cable manufacturing plant.

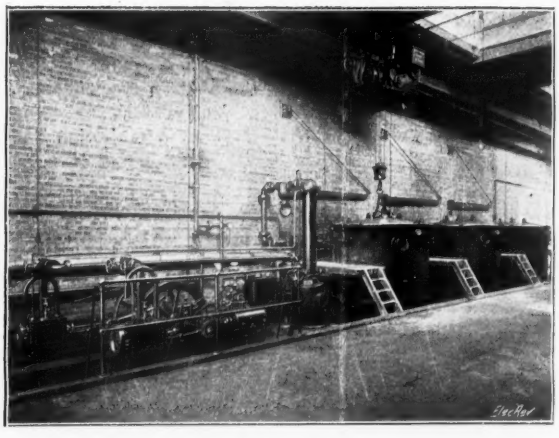
General Stores.



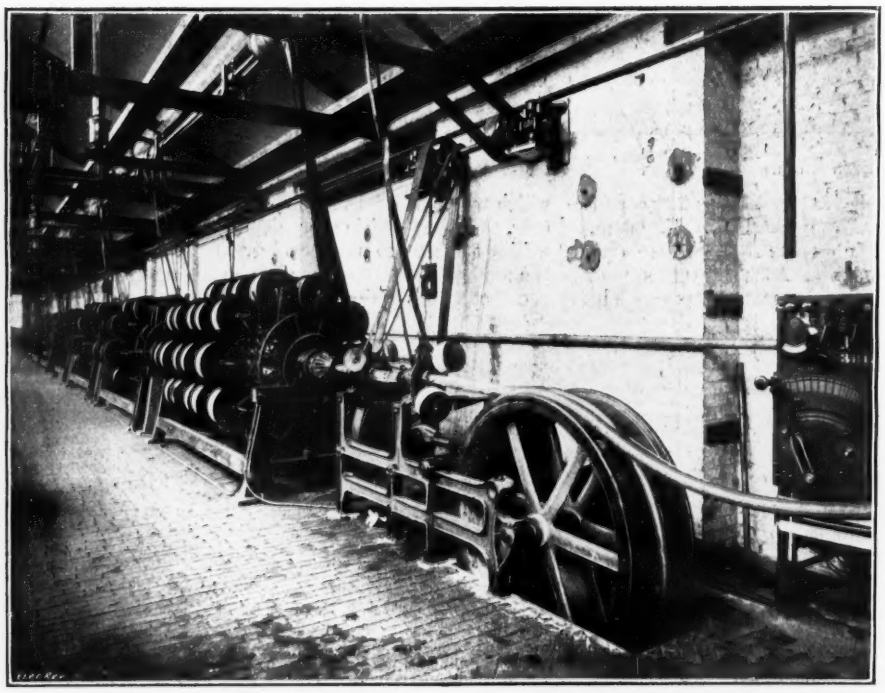
Travelling Electric Crane.

Interior of Paper-covering Shop.

The works are laid out, as far as possible, with a view to minimising the handling of material, and avoiding confusion in its passage through the shops to the shipping department. We may draw special attention to the fact that in these works the most careful consideration has been given to the system of driving; almost the whole of the machines are driven by electric motors, either individually or in groups, according to the requirements of each case, and we understand that most satisfactory results have been obtained. A large proportion of the so-called "raw material" is delivered by barge, and for its reception a wharf has been built along the river front, so that barges can be loaded and discharged in all states of the tide. A runway for cranes is provided from end to end of the wharf, and on this are mounted two electric travelling jib cranes, one of 2 tons capacity, with a radius of 40 ft., and one of 5 tons capacity at 16 ft. The former is shown in one of our views on p. 357. The wharf also allows of the dispatch of drums of finished cable, &c., by water; an alternative course is provided by a siding from the Great Eastern Railway. Coal is unloaded from barges by means of a grab, and deposited direct in hoppers projecting from the wall of the adjoining boiler house. Great quantities of pig lead are consumed, and these are carried round from the wharf to the lead press shop, or the adjoining yard, on small trucks running on a narrow gauge railway laid alongside the crane rails.

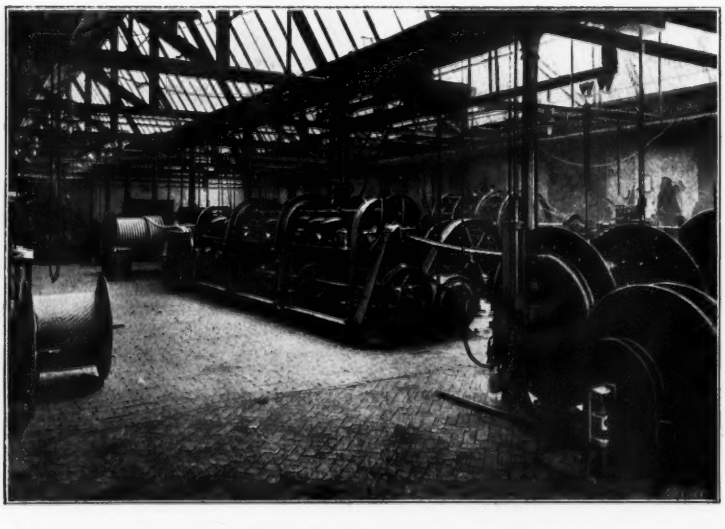


Impregnating Tanks.



500-pair Telephone Cable Stranding Machine.

The general stores are situated close to the wharf, and usually contain huge piles of copper wire and tape, rolls of paper, and other materials used in the manufacture of cables. One of our views shows part of the stock of copper, amounting to between 200 and 300 tons.



48-tape Power Cable Paper-covering Machine.

Next to the stores is the "Paper-covering shop," where telephone wires are covered with paper and paired. There are 34 paper-covering machines, each having five heads; each head is independently driven from the main shaft. The machines are arranged in pairs, with a motor between, driving both machines through flexible couplings. The motor is of the Western Electric enclosed type, rated at 2½ h.p., and drives the shafts at from 300 to 1,000 r.p.m., according to the size of wire and paper employed. To obtain this wide variation of speed, a balancer is provided which gives 110 volts in addition to the normal supply at 220 volts; the regulating switches are fed at both 110 and 220 volts, the transition from one voltage to the other being automatic as the speed is varied. The regulating switches are of a special type devised by the company for this service.

Five machines, each with six heads, are provided for lapping copper tape over wires already covered with paper; the tape is not insulated from the adjoining tapes in a

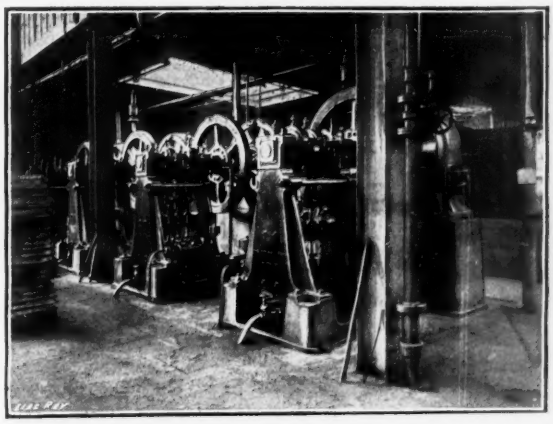
cable, the whole of the tapes being earthed. Special cables of this type are used with a view to diminishing induction between adjacent conductors. Each of these machines is driven by a motor fixed on the top of the frame, and is provided with a Western Electric, type J, automatic starting rheostat, which when switched on brings the motor up to speed by smooth steps without further attention.

There are 30 pairing machines of the ordinary type for telephone cables, each fitted with two heads, separately driven by a motor, and each motor provided with a Cutter automatic starter. Some of these machines are seen on the left hand of our view of this shop.

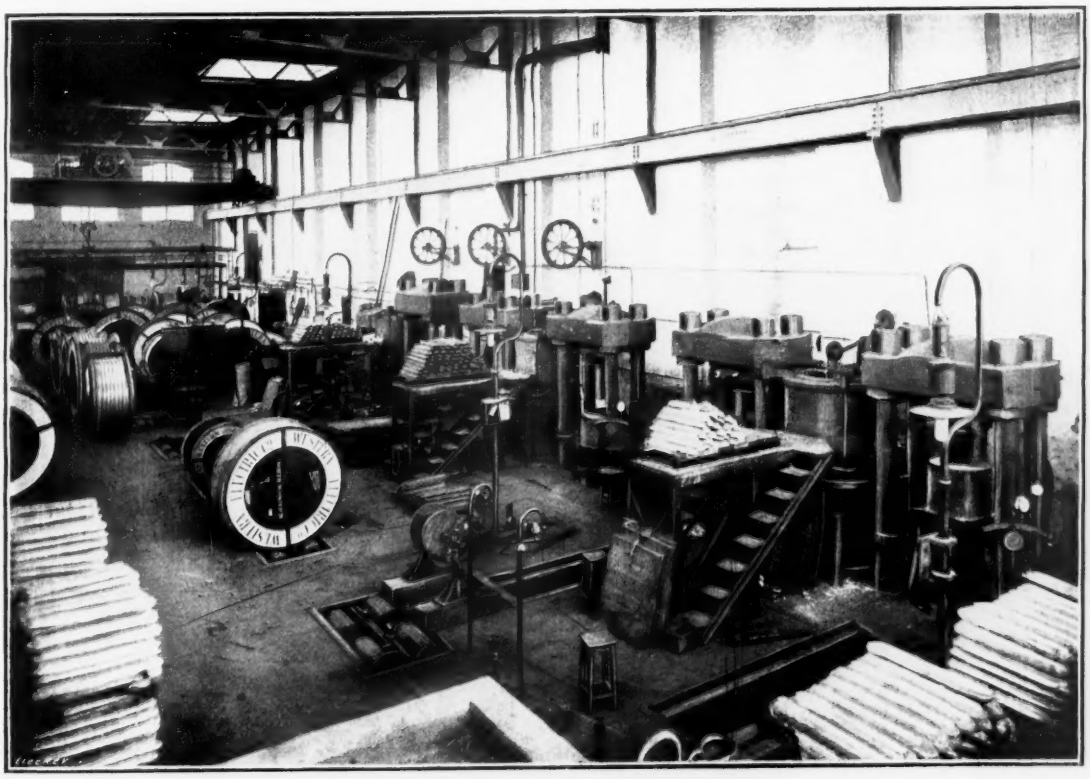
In the same shop there are six silk-covering machines, with 15 heads each, for covering with silk the wires for intermediate cables, such as are used in telephone exchanges between the underground cables and the main distributing frame, and from this to the intermediate distributing frame. Each machine is driven by a separate motor.

Eight universal winders, each separately driven, are provided; these wind the separate strands of cotton or silk from the rough spools on which they are supplied, in flat bands on paper tubes, in such a manner that the cotton or silk maintains itself in position without end flanges—a very pretty operation. This process is necessary, because the cotton cannot be used direct from the original drums upon which it is received. Ingenious devices for adjusting the tension of the cotton, automatically stopping the machine if a thread breaks, and so on, are provided in these machines, some of them, the invention of the company's staff, having resulted in increasing the contents of the finished spools by 35 per cent.—no small consideration. The bands usually contain 8 strands each, and this number can be increased or "doubled" up to 40.

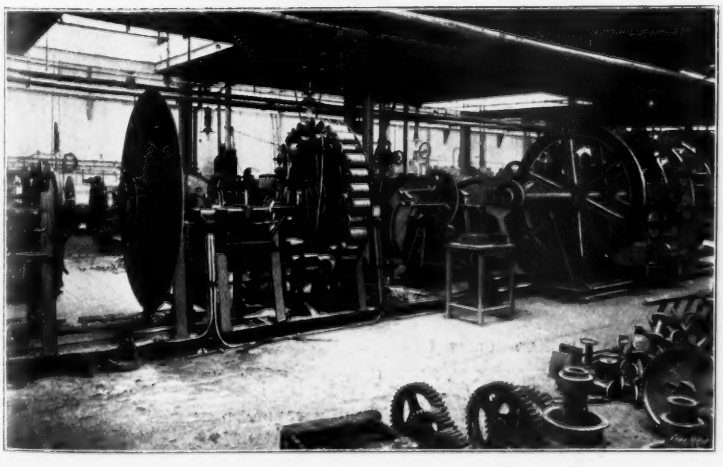
A number of machines for cutting up paper from the rolls into tapes are installed; and lastly, there are 10 braiding machines of the usual type,



Motor-driven Hydraulic Pumps.



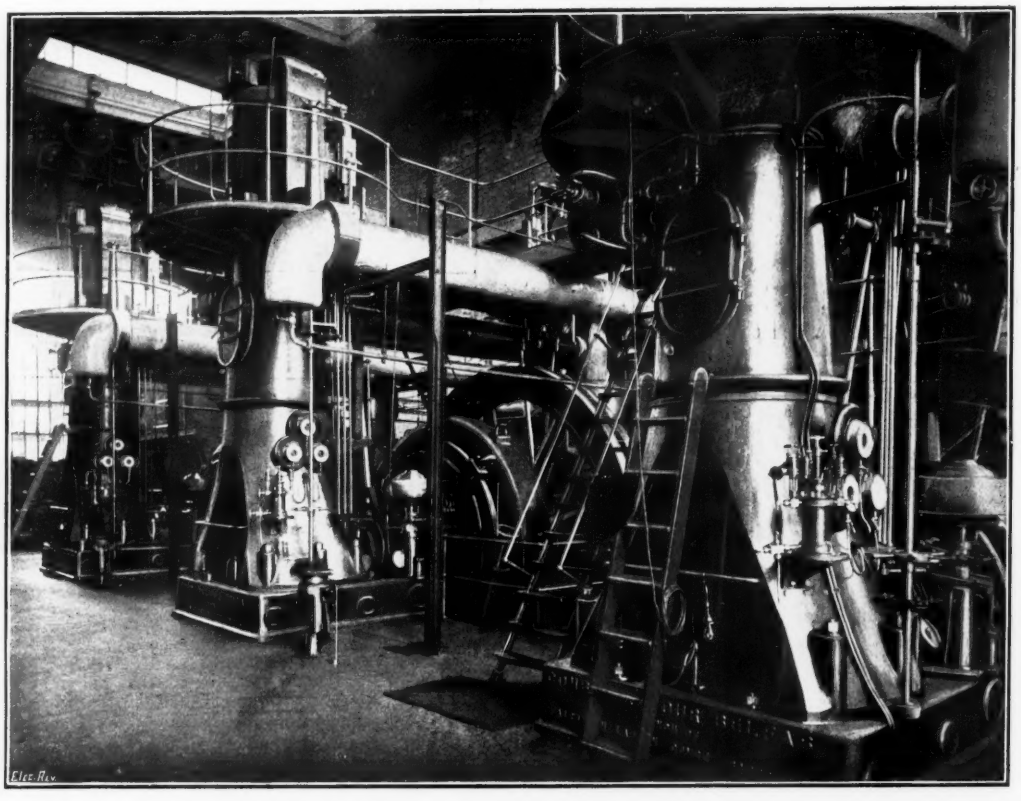
Interior of Lead-press Shop.



Armouring Machine.

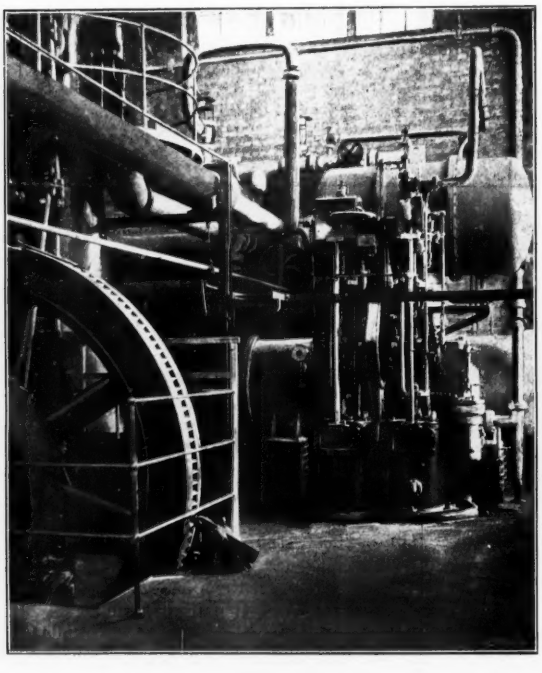
all driven from one countershaft, which in turn is driven through single-reduction gear with a rawhide pinion by a motor.

All the motors are of the Western Electric Co.'s make. The balancer is of 30 KW. capacity, and is provided with starting gear and a centre-zero ammeter. This shop, like all the others, is lighted with Western Electric enclosed arc lamps.

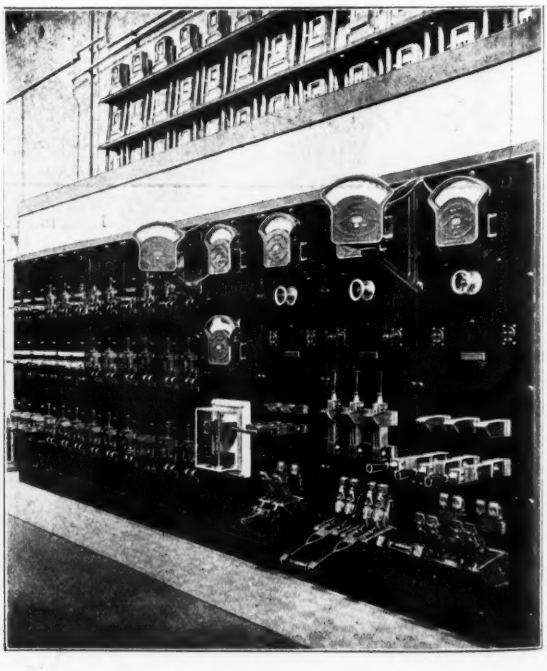


Generating Plant in Power Station.

We pass next into the stranding shop, which is used for laying up light and power cables as well as telephone cables. Dealing with the latter first, the principal machine is a huge 500-pair stranding machine, driven through a main shaft with belts by a 15-H.P. open-type motor mounted on the roof trusses. A W.E. Co. combined starter and speed regulator is provided, with an I.T.E. circuit-breaker, and press-buttons on various parts of the machine enable the latter to be instantly stopped in case of need. The machine consists of 10 sections, and extends the whole length of the shop—about 160 ft. The bobbins are made as far as possible interchangeable, and various neat little labour-



Condensing Plant.



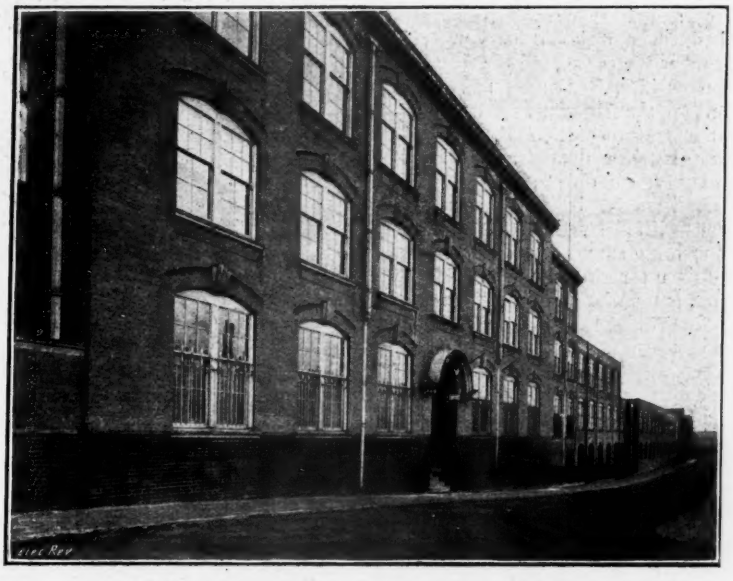
Main Switchboard.

saving devices have been embodied in the construction of the machine. Means have also been provided for increasing its capacity to more than 600 pairs when desired, and a variety of combinations has been worked out for different sizes of cable.

Near this monster is a 217-pair machine, driven by an enclosed motor, which is also mounted overhead. The whole of the larger machine is shown in one of our illustrations on p. 358.

Deferring notice of the power cable machines for the moment, we pass on to the core-testing room, whither the telephone cables are brought from the stranders on trucks, to be examined for continuity and insulation. In this room there are also six large braiders for dry-core cable, which is covered with braid prior to sheathing with lead. A Waygood electric lift conveys the cables from the core-testing room to the drying room, where there are six ovens, heated to 225° F. by steam pipes, over which a current of air is blown by electric fans. The next stage brings us to the lead presses, which are common to both telephone and power cable manufacture.

In the stranding room, besides the telephone cable stranding machines already mentioned, there are four large lighting and power cable stranding and taping machines. One of these is arranged for stranding cables containing up to 61 wires; it is shown in the background of our view (p. 358). Two paper-covering machines, with a capacity of 48 tapes each, are provided, and one with a capacity of 36 tapes; all these are driven with Renolds chain gear, by separate motors. The 48-tape machine in the foreground of the view last mentioned was covering high-tension cable for the Underground Electric Railways of London, Ltd., at the time of our visit. One of the large taping machines is provided with a 120-wire strander, for completing and taping-up concentric cables at one operation.



Western Electric Co.'s Factory, Main Entrance.

In this room there is also a six-core stranding machine for laying up the cores of three-phase high-tension cables, and similar work; this is driven by a 35-H.P. motor through spur gearing.

The impregnating tanks are shown in another illustration. There are five of these, two of which are in course of erection; they are situated in a part of the core-testing room previously mentioned. Duplicate sets of vacuum pumps, driven by steam and electric motors respectively, are provided, and over the row of tanks there is a 2-ton traveller to handle the drums of cable. The longitudinal travel of the latter is operated by means of a rope on the main and tail system, driven by a motor at one end of the run; the vertical hoist is driven by a motor mounted on the traveller itself.

We have now arrived at the lead press room, of which we give two views (p. 359). Here there are six hydraulic lead presses, working at a pressure of 3 tons per square inch; five are visible in the view, the sixth, a small one, being at the remoter end of the row. The drums on which the finished cable is wound as it comes from the presses are driven by friction rollers, each set having a 1½-H.P. motor, together with a pilot motor and extremely neat and simple regulating-gear, all of which is installed in chambers under the floor level, out of the way. A 20-ton electric three-motor crane, by Messrs. Smith & Sons, of Rodley, traverses the room from end to end, serving the three large testing tanks at the far end as well as the lead presses.

The latter are driven by means of seven hydraulic four-throw single-acting pumps, driven direct by 30-H.P. six-pole motors at 70 r.p.m., with heavy fly-wheels. The working of these sets is remarkably smooth and silent; the absence of gearing, and the low speed, greatly contribute to this result, and the pumps themselves run so quietly that their working is hardly noticeable. Special arrangements render it an easy matter to overhaul and re-pack the pumps when necessary, and all leakage of oil or water is carefully provided against.

As our illustrations show, the press room contained a large stock of lead, and numerous drums of cable, awaiting testing or ready for shipment. Amongst others there were power cables for the Underground Electric Railways, Bloemfontein Municipality, &c., and telephone cables for the British Post Office, Port Elizabeth, the Australian Commonwealth Post Office, and the National Telephone Co. The latter company had a special submarine cable going through, lead covered and double armoured.

The armouring department is situated at the rear of the shop last mentioned; it will be noticed that all the shops are so arranged in order that the work goes continuously forward without a check. A large machine is here installed for laying on steel wire and tape armouring; it is driven by a 35-H.P. motor, of the semi-enclosed type, with auto-starter, and buttons for emergency stops. Universal winders are also provided for winding hemp from the rough hanks in which it is received into compact spools on paper tubes. One of our views on p. 359, shows the armouring machine.

Adjoining the testing tanks at one end of the lead press shop is a series of test rooms, equipped for all the usual insulation and break-down tests applied to cables. A Crompton-Brunton single-phase alternator is provided, generating at 110 volts, 70 cycles; this is driven by belt from a Western Electric motor, and is used in connection with a Wagner 30-KW. transformer. The secondary of the latter is wound in six sections, giving 6,500 volts each, which are connected with a plug board, so that a pressure of about 40,000 volts is available. The switchboard is equipped with three adjustable circuit-breakers, respectively rated at 35—75, 75—150, and 150—300 amperes; these are on the low pressure side of the transformer, and can be put in circuit as desired by means of two throw-over switches. An A.C. ammeter, a voltmeter, and a regulator for the excitation of the generator are provided; and there is a separate motor-starting switchboard.

The test room is equipped with Kelvin voltmeters reading to 50,000 and 20,000 volts respectively, and an Ayrton and Mather voltmeter reading to 5,000 volts; an Elliott potentiometer and slide resistances; storage cells for use in connection with the tests, with charge and discharge switchboard, and all necessary galvanometers, keys, &c. There are five separate rooms each completely equipped with the ordinary testing apparatus, which is conveniently fitted in roll-top desks, so that it can readily be covered up and protected from dust when not in use. Other rooms are provided for the use of engineers and inspectors visiting the works to inspect and test cable.

The shipping department is close to the testing tanks, and is so arranged that the drums of cable, when lagged up, can easily be shipped on board railway trucks and dispatched to their destination.

On p. 360 we give some views of the power station; the engine room is of imposing dimensions, and contains three generating sets, each consisting of a Combe-Barbour vertical compound condensing engine, driving direct a Western Electric dynamo. The engines are fitted with Corliss valve-gear, with trip valves on the steam admission, and run at 100 r.p.m. with steam delivered at 135 lb. per sq. in., superheated 30° F. at the engines. There are two sets giving 368 KW. each, and one of 138 KW., and all three are fitted with the "Monarch" engine stop, controlled by buttons on the switchboard panels. The generators are of the usual type, with 10 poles, compound-wound, running at 225 volts. Power is always on the circuits, day and night.

The condensing plant was supplied by Messrs. Combe, Barbour, and includes a Holden & Brooke grease separator, surface condenser and Edwards air pumps driven by a compound steam engine with fly-wheel. The centrifugal circulating pump is motor-driven, and derives its water supply from the river.

There are two Babcock & Wilcox boilers, fitted with chain-grate stokers and the usual type of superheater, capable of giving 90° F. superheat. Each boiler has 4,000 sq. ft. heating surface, and either is capable of supplying all the steam required. The make-up feed water is obtained from the East London Water Co., and is very hard, averaging 18°; a Paterson purifier, feed-heater and grease extractor is provided to prepare the feed-water for use in the boilers, delivering it at a temperature of 200° F. There is also a Green economiser, giving a final temperature of 275° F. Blake-Knowles vertical direct-acting Simplex pumps are provided in duplicate for boiler feeding. The works are heated throughout with Messrs. Rosser & Russell's hot water system, the water being supplied at a temperature of 190° F.; and a steam-driven centrifugal pump, made by Messrs. W. H. Allen & Son, is used for circulating the water through this system. The boilers are provided with mechanical draught, produced by a Sturtevant fan in a room over the boiler house. The engine room is traversed by a 20-ton crane, by Messrs. Smith & Son, of Rodley; this is hand-operated, but is being fitted with an electric hoist. Motor-driven machine tools are also provided in the engine room.

The main switchboard, which is situated in front of the generating sets, was built by Messrs. Nalder Bros. and Thompson, Ltd., of enamelled slate, and is fitted with Elliott instruments, Western Electric switches, Cutter circuit breakers, and a Thomson watt-hour-meter. The board comprises 10 panels, and provides for 36 feeder circuits, most of which are already in use; the standard feeders are rated at 100, 200 and 300 amperes each, and a separate Chamberlain & Hookham ampere-hour-meter is provided, over the switchboard, for each circuit. There are four large ammeters, and two voltmeters, one of which is fixed on a swing bracket in front of the board.

A complete plant is provided for the manufacture of pure and vulcanised rubber-covered cables; but as this department is in course of reorganisation, and the new buildings are not yet completed, a detailed description need not be given at present. Eventually all the machines in this department will be separately motor-driven.

Other shops are the fitters' and carpenters' shops, instrument warehouse, general stores, and a special workshop for the small tools used in the works. As already indicated, all stock is stored, as far as possible, close to the machines for which it is required, in sub-stores in the various departments. All the buildings are "fireproof," and are protected against fire by Grinnell sprinklers, for the service of which there is a large elevated tank capable of holding 32,000 gallons of water, and fed by special fire-pumps. The yard is paved with blue bricks.

The employés on the works number between four and five hundred, while there is a considerable number in addition employed on cable laying for the company in various towns. "Dey" time recorders are used throughout the works, and are controlled electrically by a master clock on the Synchronome system.

We have not space to describe in detail the office-buildings, which include a thoroughly equipped chemical laboratory, and a telephone exchange by means of which all departments are able to obtain immediate communication with each other, the City office, and exchange subscribers; but it may be said that all the offices are roomy and well lighted, and include careful provision for the comfort and well-being of the staff.

In conclusion, we have to express our thanks to Mr. J. E. Kingsbury, general manager, Mr. A. Williamson, works manager, and Mr. A. T. Turney, contract manager, for the facilities and assistance afforded us in the preparation of this article. We are especially indebted to Mr. R. Tervet, works superintendent, for his patient collaboration in that process, and to Mr. Spurling, the construction engineer, for kind assistance.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—Mr. J. M. BOWMAN, managing engineer of the North Metropolitan Electrical Power Distribution Co.'s Electricity Works, High Barnet, has now been appointed to a similar position at Hertford.

Mr. A. F. MCCANN, A.M.I.E.E., of the North Metropolitan Electric Power Distribution Co.'s power house, Willesden, has now been appointed managing engineer at High Barnet.

Mr. W. A. CHAMEN, chief engineer to the Glasgow Electricity Department, has resigned his position, having accepted an important appointment with Messrs. Bramwell & Harris, consulting engineers, London.

Tramway Officials.—By 21 votes to 17, Southampton T.C., on February 22nd, decided to appoint a general manager of the electric tramways, including the control of the electrical equipment and permanent way at a commencing salary of £500 a year, rising by £25 per annum to a maximum of £600.

Mr. Conaty, of Birmingham, has withdrawn his candidature for the post of general manager of the tramways at Newcastle-on-Tyne. Only Mr. HATTON (Salford) and Mr. YERBURGH (Sheffield) are left for the post.

Mr. C. A. KING, permanent way inspector of Glasgow Corporation tramways, has resigned, having accepted an appointment under Mr. Yerkes.

In consequence of Mr. Holliday, the tramways engineer and manager, having tendered his resignation, and it having been accepted by the Brighton Council, the Tramway Committee have passed a resolution recommending that the question of the appointment of a tramways engineer and manager be deferred until the expiration of three months from the date of Mr. Holliday's retirement on April 30th next, and that in the meantime Mr. MARSH, the assistant engineer and manager, perform the duties of the office. Mr. Marsh, before going to Brighton 4½ years ago, was in the service of the Glasgow Corporation Tramways.

Mr. WILLIAM GRANT, tramway manager, Rotherham, has been appointed manager of the Ayr Corporation tramways. Mr. Grant has had 12 years' experience of tramway work under the Corporations of Blackpool, Darwen and Rotherham.

General.—Mr. F. S. SHAW, A.M.I.E.E., of the well-known electrical and mechanical engineering firm of L. J. Healing and Co., Yokohama, Kobe and Tokyo, Japan, is now on his way to England, and is expected to arrive in London about March 20th.

The King has appointed the Hon. A. E. GATHORNE-HARDY to be a Commissioner under "The Railway and Canal Traffic Act, 1888," in the room of Viscount Cobham, resigned. Mr. Gathorne-Hardy will also act as chairman of the Light Railways Commission.

We learn that the Union Electric Co., Ltd., of Queen Victoria Street, E.C., owing to the growth of their export business, are sending out one of their most experienced officials, Mr. C. O. BARWELL, for a trip through the British Colonies—in fact, round the world. The main objects of the trip are to ascertain the condition of the Colonial markets, push the sale of Union goods, appoint agents and carry out other commissions. We understand that Mr. Barwell is in a position to represent one or two other leading electrical firms whose interests do not conflict with those of the Union Co.

NEW COMPANIES REGISTERED.

Electric Flash Lights, Ltd. (83,520).—This company was registered on February 9th, with a capital of £25,000 in £1 shares, to acquire from B. Sherman, of 16 and 17, Devonshire Square, London, the benefit of certain existing inventions relating to electric flash light advertising, to adopt an agreement with the said vendor, and to carry on the business of advertising agents and contractors, electric engineers, manufacturers of and dealers in all kinds of electrical machinery, fittings and appliances, &c. The first subscribers (each with one share) are:—J. J. Sheehan, 81, Woodbury Street, Tooting, clerk; B. Sherman, 16—17, Devonshire Square, E.C., electrical engineer; W. Johnson, 67—68, King William Street, E.C., gentleman; V. Ludbrook, 5, Wills Street, W.C., clerk; R. Grimwood, Constitutional Club, Chertsey, clerk; T. C. Ashcroft, Anlac, Pinfold Road, Streatham, clerk; and E. P. Cook, Aberdour, Holstein Avenue, Weybridge, clerk. No initial public issue. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; qualification, £100 shares or stock; remuneration (except managing director), £100 each per annum.

Holman James & Co., Ltd. (83,604).—This company was registered on February 17th, with a capital of £300 in £1 shares, to acquire from W. H. James British patents for an improved electric fuse-box, single and double-pole, granted to him on November 23rd, 1904, and numbered 25,478, together with the right to contract for, sell and deal in, in the counties of Buckingham, Berks, Middlesex, Kent, Surrey and Oxford, electrical and other goods manufactured, sold or dealt in by Headley, Ltd., to carry on at Maidenhead or elsewhere the business of electrical engineers, contractors and fitters, &c., and to adopt agreements (1) with W. H. James and (2) with Headley, Ltd. The first subscribers (each with 25 shares) are:—J. B. Ormond, Little Copped Hall, Epping, land steward; F. J. Lukies, Shingle Hall, Sawbridgeworth, Herts., farmer; L. J. Pinch, Ashlyns Farm, Ongar, Essex, farmer; T. L. Lukies, Cammas Hall, Hatfield, Broad Oak, Essex, farmer; F. N. Lukies, Chamber's Manor, Epping, Essex, farmer; P. Pinch, Mayles, Epping, Essex, farmer; and W. H. James, 100, Queen Street, Maidenhead, electrical engineer. No initial public issue. The number of directors is not to be less than three nor more than seven; the first are J. B. Ormond (chairman), F. J. Lukies, L. J. Pinch, T. L. Lukies, F. N. Lukies and W. H. James; qualification, £25; remuneration as fixed by the company. Registered office, 100, Queen Street, Maidenhead.

Zea Arc Lamp Co., Ltd. (83,613).—This company was registered on February 17th, with a capital of £1,000 in £1 shares, to carry on the business of lamp manufacturers, suppliers of electric light, electricians, engineers, &c., and in particular to take over from E. G. Abrahams, of 2, Staple Inn, London, the benefit of certain inventions relating to arc lamps. The first subscribers (each with one share) are:—J. F. Kean, Morning Lane, Mare Street, Hackney, clerk; C. W. E. Pinco, 33, Guildford Street, W.C., civil engineer; T. K. Thomborrow, 2, Gray's Inn Place, W.C., law stationer; W. H. Betts, company director; J. H. Dodson, 19, Goodall Road, Leytonstone, clerk; H. James, 15, Warwick Court, W.C., piano manufacturer; and J. L. M. Bébéville, Lordship Park, N., secretary. No initial public issue. Registered without articles of association. Registered office, 2, Staple Inn, Holborn.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Automatic Electrical Advertising Syndicate, Ltd. (62,115).—This company's annual return was filed on December 28th, when the entire capital of £4,500 in £1 shares had been taken up. £3,000 has been paid, and £1,500 is considered as paid. Mortgages and charges: Nil.

Havana Electricity Co., Ltd. (77,897).—A trust deed dated January 19th, 1905, to secure £150,000 debentures, created same date, has been registered. Property charged: Certain bonds of the La Compania de Electricidad de Cuba for $1,500,000 U.S. gold, and the company's undertaking and other assets, present and future. Trustees: H. Rüffer, Menival, Sydenham, and Major W.E. E. Gordon, M.P., 4, Chelsea Embankment, S.W.

Northwich Electric Supply Co., Ltd. (46,958).—A trust deed dated January 12th, 1905, to secure £11,000, has been registered. Property charged: The company's freehold and leasehold lands and hereditaments, and its undertaking and property, present and future. Trustees: Brunner, Mond and Co., Ltd., Winnington, Northwich.

Chelmsford Electric Lighting Co., Ltd. (36,124).—A memorandum of satisfaction in full of a debenture stock trust deed dated December 21st, 1903, securing not more than £20,000, has been filed.

Hastings and District Electric Tramways Co., Ltd. (82,521).—A trust deed dated November 20th, 1904, to secure £250,000 debenture stock, has been registered. Property charged:—35,880 shares in the Hastings Tramways Co., and the company's other assets and undertaking, present and future. Trustees:—Debenture Securities Investment Co., Ltd., 12, Moorgate Street, E.C.

Worcester Electric Traction Co., Ltd. (74,698).—An acknowledgement of indebtedness under seal dated January 27th, 1905, creating £10,000 further debenture stock, making with £10,000 already created a total of £20,000, and being supplemental to a time deed dated October 22nd, 1903, securing £10,000 of such debenture stock, registered. The company takes power to issue further debenture stock ranking *pari passu* up to half its issued capital. Property charged: The company's assets, present and future. Trustees: Electric and General Investment Co., Ltd., 1-2, Great Winchester Street, E.C.

Typewriter Telegraph Corporation, Ltd. (66,332).—Issue on January 25th of £640 debentures, part of series created November 14th, 1904, to secure £3,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. No previous issue of same series.

Schattner Electricity Meter Co., Ltd. (name since changed to "Engineering Instruments, Ltd.").—This company's annual return was filed on January 9th, when 15,000 ordinary and 12,500 deferred shares had been taken up out of a nominal capital of £50,000 in 37,500 ordinary and 12,500 deferred shares of £1 each. 15s. per share has been called up on the ordinary shares, resulting in the receipt of £11,250. 12,500 deferred shares are considered as fully paid. No mortgages or charges.

Lancashire Electrical Engineering Co., Ltd. (56,992).—This company's annual return, made up to May 6th, 1904, was filed on February 2nd, 1905, when 1,883 shares had been taken up out of a nominal capital of £5,000 in 5,000 shares of £1 each. £1 per share has been called up on 50 shares, resulting in receipt of £50. 1,833 shares are considered as fully paid. No mortgages or charges.

British Railway Traffic and Electric Co., Ltd. (74,227).—This company's annual return was filed on January 13th, when 60,000 shares had been taken up out of a nominal capital of £100,000 in 100,000 shares of £1 each. £1 per share has been called up on 7, 10s. on 5,000, and 6s. per share on 54,993 shares, resulting in the receipt of £19,004 18s. No mortgages or charges.

Woking Electric Supply Co., Ltd. (46,175).—Issue, on January 21st, of £200 debentures, part of series created November 2nd, 1899, to secure £25,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £24,650.

Llangollen and District Electric Light and Power Co., Ltd. (75,384).—A debenture, dated February 4th, 1905, and a mortgage of even date (by way of collateral security), to secure £1,000, have been registered. Property charged (by debenture): The company's undertaking and property, present and future, including uncalled capital. (By mortgage): Certain leasehold premises. Holder: S. L. Jones, Glanrafon, Llangollen.

Direct United States Cable Co., Ltd. (11,597).—This company's annual return was filed on February 15th, when 60,710 shares had been taken up out of a nominal capital of £1,300,000 in 65,000 shares of £20 each. £1,214,200 is considered as paid. No mortgages or charges.

Costa Rica Electric Light and Traction Co., Ltd. (56,417).—This company's annual return was filed on January 17th, when the entire capital of £180,000 in 180,000 shares of £1 each had been taken up. £7 has been received, and £129,993 shares are considered as fully paid. Mortgages and charges: £162,100.

Bridgwater and District Electric Supply and Traction Co., Ltd. (75,423).—Particulars of £12,000 debentures, created by resolution of November 11th, 1903, have been filed pursuant to Section 14 (4) of the Companies' Act, 1900. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Electric Light and Power Co. of Japan, Ltd. (60,811).—This company's annual return was filed on January 4th, when 7 shares had been taken up out of a nominal capital of £3,000 in £1 shares. No calls have been made. Mortgages and charges: Nil.

Adelaide Electric Tramways, Ltd. (65,676).—This company's annual return was filed on January 4th, when 7 shares had been taken up out of a nominal capital of £3,000 in £1 shares. No calls have been made. Mortgages and charges: Nil.

British Thomson-Houston Co., Ltd. (47,982).—This company's annual return was filed on January 6th, when the entire capital of £800,000 in 40,000 ordinary and 40,000 preference shares of £10 each had been taken up. £10 per share has been called up on 32,531 ordinary and 40,000 preference shares, resulting in the receipt of £725,310. £74,690 is considered as paid on 7,469 ordinary. Mortgages and charges: £212,000.

CITY NOTES.

Nernst Electric Light, Ltd.

This company held its adjourned meeting on Thursday last week at the Westminster Palace Hotel to consider further the election of a director, a subject to which we referred in some detail in our issue of January 27th. We need not enter further into the dissensions which have found their way into the company's There were many speeches made at last week's meeting, but all that is of any real concern to our readers is the decision which was arrived at as a result of the poll. The proposal of the board that Mr. R. J. Wallis-Jones be re-elected received 37,344 votes, and that of Mr. Oppenheimer inviting Sir H. Seton-Karr, M.P., to join the board received 30,359—a majority of 6,985 for Mr. Wallis-Jones. When these figures were announced to the meeting the motion was formally put and Mr. Wallis-Jones was unanimously re-elected. We are glad that the company has adopted the more prudent course advocated by us when we last dealt with the matter, and for the best interests of all it is sincerely to be hoped that there will be peace, for a time at any rate. That is necessary if the company is to use its entire forces for doing successful business in its several markets, maintaining, and, it is hoped, increasing the dividend now that its shareholders have, after much waiting, had a taste of that delicacy.

Cambridge Electric Supply Co.

The annual meeting of this company was held at Cambridge on Wednesday last week, Mr. D. Mansey presiding. The annual report was published in our issue of February 17th.

The Chairman said that the year had been full of work, as the buildings had been extended and the plant increased. The new works had been completed, and during the past year they had supplied an increase of 51,000 units. He called their attention to a reduction in the price of energy from 7d. to 6d., by which they hoped to increase the demand and also the dividend. If their present increase was maintained they would soon make up what they had given away. During the year they had called up £1 a share, and debentures had also been issued, which had been over-applied for. In the present year they would have more time to benefit their business, and they looked forward to a prosperous year. Now they had got accommodation for 20 or 30 years, and consequently they would not be troubled with such difficulties.

Mr. J. B. Simpson seconded, and the report was adopted.

South Metropolitan Electric Light and Power Co.

The meeting of this company was held on Monday, at Winchester House, Mr. Henry St. John Winkworth presiding.

In proposing the adoption of the report, the Chairman said the company continued to make satisfactory progress, the number of lamp connections having increased by 47,851, of which 18,279 were added during the year, and 29,572 were taken over with the undertaking of the Crystal Palace District Electric Light Co. in June last. Exclusive of the Crystal Palace area, this was the largest increase they had had, and made the total 8-c.p. equivalents connected at the end of the year 108,391. The number of consumers had increased to 2,555, and the net revenue had improved from £11,041 to £16,574, an increase of 50 per cent. over the corresponding period of last year. The directors felt that the best interests of the company would be served by pursuing a prudent and sound policy, and so strengthening the position of the company, which they believed would ultimately prove beneficial to the proprietors, and the majority of the shareholders had sent proxies to the directors in support of the policy which the board recommended for the disposal of revenue. Since they had met they had approved the change of name to the South Metropolitan Electric Light and Power Co., and seeing that they had increased their area by the addition of the Crystal Palace, Lewisham and Penge orders, he thought the new title more adequately represented the importance of their undertaking, which embraced an extensive area of 15 square miles, with a present population of about a quarter of a million. They had

acquired the Crystal Palace business on very favourable terms, and the area not only consolidated their position by linking up Lewisham and Penge, but the district was capable of considerable development, and their experience during the last few months had shown that the new area, worked in conjunction with the other districts of the South Metropolitan Electric Light and Power Co., would act as a valuable feeder, and would help them to progress more satisfactorily, and in greater ratio of progress than if they had not acquired this area. The work in connection with the change of system had made satisfactory progress. About one-fourth of the consumers had already been changed over, and were being supplied in the daytime from their generating station at Greenwich, and it was confidently expected that the whole of this area would be changed over during the present year. When this was completed, the company would begin to reap the benefit of the more economical working of this portion of its undertaking. The purchase price for the sale of a small portion of the new area to Beckenham had not yet been adjusted. The price, however, was fixed by the provisional order at the capital expenditure plus 33 per cent. The company would shortly require to raise further capital for the completion of the purchase of the Crystal Palace District undertaking, and to provide for the continued development of the business. The precise form the issue would take would depend upon the condition of the market at the time, but it was proposed to offer the new capital to the shareholders. The profit earned on the average capital expenditure, which was 3·58 per cent. in 1902, increased to 4·47 per cent. in 1903, and 5·57 per cent. in 1904, and they had every reason to believe the progress would continue. The district was a rapidly improving one. Building operations on a very extensive scale were going on, and large estates were now being developed in Lewisham, Sydenham and Penge, where several hundreds of houses and shops were being erected and wired for electric light, which would mean a large accession of business to the company as those new buildings became tenanted. The prospects of business were promising, and he thought they might anticipate a favourable result for the current year.

Mr. Henry W. Bowden, M.I.C.E., M.I.E.E., managing director, in seconding the motion, referred to the purchase of the Crystal Palace undertaking. He said that last year he stated at the annual meeting that he estimated the capital outlay to change the system from direct to alternating current would be about £30,000. The actual cost had been only £25,000. The first new 250-kw. alternator was delivered in November last, and was now running daily during the evening (third shift), supplying energy to that portion of the area changed over, and to the new customers obtained south of Catford Bridge. The second alternator would be delivered during the present week, and would be available by the end of March. For convenience in working, the area had been divided into "northern" and "southern." The alternating machinery was shut down daily after the evening's run, and the supply was then given from the Greenwich station. Although only about 25 per cent. of the area had been changed over, they had already benefited by a reduction in the working costs, and an improvement had been effected in the lighting. The improvement in the efficiency of distribution was being obtained by placing their transformers, which, in the majority of cases, were placed in tanks buried in the ground, where the demand was likely to be made, thus reducing the capital outlay on cables, and dispensing with all moving machinery at the sub-stations. The sub-stations, as worked by the late Crystal Palace Co., were costly to maintain, because they required daily attendance for the moving machinery. At this time last year the company was under the impression that the demand in the Crystal Palace and Penge areas would be very small during the day time, and that very probably the supply could be given from the station at Greenwich. A demand for power was not anticipated in an almost purely residential area. He was, however, pleased to say that they had recently entered into a power contract where the minimum consumption was to be 50,000 units per annum for a period of five years; so that it might be necessary to run both stations during the daytime, only shutting down the Sydenham station after the third (evening) shift. Although the cost per unit for that area was very high, he had every hope of seeing the cost considerably reduced. Referring to the northern area, he said that the coal cost was ·61d., and the working cost ·9d. per unit. Here the demand for power was nearly 50 per cent. of the total units generated, and in order to encourage still further that part of their business, they had amended their prices during the past year, as the load factor had increased from 11 per cent. to over 15 per cent. Since they had completed the change-over in Greenwich from direct to alternating current the efficiency of distribution for the northern area had increased from 67 per cent. to over 72 per cent.

In a lengthy discussion which followed, Mr. Boot, a shareholder, severely criticised the policy of the board. He complained that there was no dividend for the ordinary shareholders, and said that it was his intention, if he could find a seconder, to move that the report be not accepted, and that the meeting be adjourned.

Mr. Hughes seconded that, remarking that the ordinary shareholders were absolutely sick with hope deferred.

Mr. Kershaw, one of the original directors of the company, while regretting that there was no dividend on the ordinary shares, considered that the board should pursue a wise and prudent policy.

In the course of further discussion, which turned on the appointment of Mr. May, that gentleman spoke of his willingness to retire, as he had no wish to force himself on unwilling shareholders. This was met with cries of "No! no!" and on Mr. Boot's amendment being put, it was defeated.

The original motion was then carried unanimously, Mr. Winkworth was re-elected a director, and the proceedings terminated with a vote of thanks to the chairman.

Notting Hill Electric Lighting Co.

The directors report that during the year 1904 the expenditure on capital account has been £7,932, making a total of £224,267. The principal items are £2,225 12s. 6d. for new mains, and £3,973 for a new battery of accumulators erected at the Bulmer Place station. To meet this expenditure 4 per cent. debentures amounting to £9,000 have been issued. The cost of the joint station to date has amounted to £149,519, and joint debenture stock amounting to £152,500 has been issued. This stock is subject to a cumulative sinking fund, which now amounts to £12,705, invested in trustee securities. The following table shows the progress during the last four years:—

	Equivalent of 8-c.p. lamps.	Profit.
1901	82,054	£13,016
1902	99,497	14,609
1903	116,360	15,018
1904	132,192	19,890

The number of consumers is now 2,267, and nearly 98 per cent. of these are supplied at 200 volts. The gross revenue for the year was £34,564, showing an increase of £5,120, and the total net profit was £19,890, being an increase of £4,872. From the net profit of £19,890 the following sums have to be deducted:—Depreciation, renewal and reserve fund, £2,750; debenture interest, £2,450; Kensington and Notting Hill joint debenture stock interest, £1,952; sinking fund, £1,075; = £8,227, leaving a balance available for dividend of £11,663. The directors recommend that the usual dividend of 6 per cent. on both the preference and ordinary shares be paid, amounting to £8,310, and that the balance of £3,353 be divided in accordance with the articles of association, one-half (amounting to £1,677) being credited to the founders' shares, and the other half to the ordinary and preference shares. This will enable a further 1 per cent. to be paid on both ordinary and preference, with a distribution of £3 per share on the founders' shares. An interim dividend of 3 per cent. was paid to the holders of the ordinary shares on July 1st, and the balance of 4 per cent. will be paid forthwith, together with the distribution on the founders' shares. The preference shares having received their full 6 per cent., the 1 per cent. bonus will be added to the interim dividend on these shares, to be paid on July 1st next.

The attention of the shareholders is called to the increased amount levied for rates; the sum of £2,099 having been paid during the past year, in addition to £460 representing the company's proportion of the rates at the Wood Lane station. These rates are levied upon the earning power of the machinery and mains, and are the equivalent of an income-tax of about 4s. in the £ upon profits distributed to the shareholders in addition to the usual income-tax paid to the Inland Revenue. It is to be hoped that Parliament in the near future will take up seriously the question of basing rateable value upon the annual earnings of machinery used for production. Law costs have been incurred owing to the necessity of having to oppose before Parliament Bills promoted by other companies which might injuriously affect the interests of this company. During the present Session a considerable amount will have to be expended, as a large number of schemes have been brought forward for various projects in connection with the supply of electricity. In many of these Bills clauses have been inserted authorising the undertakers to supply electricity in all parts of London, and although there does not on the face of these Bills appear to be any intention actively to compete with this company, the directors have considered it necessary to take steps to oppose clauses which might at some future date prove prejudicial. It is a legitimate grievance that promoters should be able wantonly to submit the company to continuous and unnecessary expense of this nature. The directors regret to announce the death of their colleague Mr. W. H. Willans, whose great business experience was of such value to the company. To fill the vacancy thereby created they elected Mr. Richard Biddulph Martin, M.P., of 68, Lombard Street, E.C.

Statement of Electricity Generated, Sold, &c., During the Year ending December 31st, 1904.

Quantity generated in B.O.T. units	1,863,727
Quantity sold—	
Public lamps	84,613
Private consumers by meter	1,560,879
Total sold	1,615,492
Quantity used on works	23,676
Total quantity accounted for	1,669,168
Quantity not accounted for, including loss in distribution	194,559
Number of public lamps	52
Total maximum supply demanded	1,350-kw.

London United Tramways (1901), Ltd.

The report for 1904 states that the gross receipts have amounted to £296,235, and working and general expenses and renewals to £176,188, leaving, with the balance brought forward a net revenue of £120,834. After payment of debenture interest and dividend on the 5 per cent. preference shares, there remains £42,087 (including £3,750 net premiums on new preference shares). An interim dividend at the rate of 6 per cent. per annum has been paid on the ordinary shares, and it is now proposed to pay a final dividend at the rate of 6 per cent. per annum, placing £5,000 to credit of reserve fund, and carrying £563 forward. The gross receipts show an increase of £15,993, but the operating expenses have decreased by £203, notwithstanding the larger mileage open as compared with the previous year. The total number of passengers carried was 48,126,727, an increase of 2,833,254. Debenture interest and preference dividend together absorb £82,497, as compared with £58,826 in the previous year. This arises in consequence of the expenditure of capital which the directors have considered it expedient to incur for the purpose of carrying out important road improvements and widenings on various parts of the company's system. These works afford valuable facilities for the conduct of the present traffic, and would have involved a greatly enhanced capital outlay if deferred to future years, when they must become essential to the proper development of the company's business. The extension from Southall to Uxbridge *vid* Hayes and Hillingdon, and also the connecting line from Hammersmith Broadway *vid* Askew Road, were opened for public traffic in June last, and the results have fully realised anticipations. During the summer months especially this attractive route was largely used by passengers who availed them-

selves of the new facilities for reaching the town of Uxbridge. The Bill promoted by the company in the last session of Parliament to authorise an extension from Hounslow to Staines received the Royal assent on August 15th. Preparations are in progress for the construction of the authorised tramways in Kingston, Surbiton, The Maldens and Wimbledon, and between Brentford and Hanwell. These Surrey lines will link up important centres of population, and will connect with the London County Council electric tramways system at Tooting and over Kingston Bridge with the company's tramways in Middlesex and London.

British Electric Transformer Co.

The directors report that for 1904 the accounts show that after paying all manufacturing costs and the expenses of administration there remains a net profit of £12,030, which, with the amount brought forward from last year (£1,573), makes a total available balance of £13,603. The board recommend that this balance shall be allocated as follows:—

To depreciation reserve	£1,500
To reserve fund	2,000
To preliminary expenses written off	1,500
To payment of preference dividend of 6 per cent. (£537 12s. paid August 1st, 1904)	1,151
To payment of a dividend of 7½ per cent. on the ordinary shares	4,958
To carry forward a balance of	2,495

The two new bays mentioned in last year's report have been completed and fitted with the necessary plant. This extension of the works has been of great value, and has enabled the company to deal with the increased volume of business. In spite of the general depression in trade the works were fully occupied and running overtime during the whole year.

City of London Electric Lighting Co.

The directors report that during 1904 the expenditure on capital account amounted to £55,827. The revenue for the year was £255,087, plus interest on investments and discounts, £1,751, = £256,838. Expenses of generation and distribution were £59,119; repairs and maintenance of buildings, machinery, plant, mains and other works, £13,416; rent, rates, taxes, management expenses and special charges, £40,184 = £112,719; interest tranferred to debenture stock premium redemption fund amounted to £1,221, and staff superannuation fund, £306; = £114,246, leaving £142,592 plus £21,882 balance brought forward; making a total available revenue of £163,474. Interest on loan from bankers, deposits, &c., absorbs £2,136; interest on first and second debenture stock, £31,860; there is transferred to reserve account £45,000, and for leasehold redemption £500. The directors recommend that the following dividends for the year be declared:—

Preference shares Nos. 1 to 40,000.—12s. per share, being a distribution for the year at the full rate of 6 per cent. Of this sum 6s. per share was paid in July, £11,425, leaving a balance of 6s. per share for present distribution.

Ordinary shares Nos. 40,001 to 110,595.—12s. per share (6 per cent. for the year). Of this sum 5s. per share was paid in July, £16,893, leaving a balance of 7s. per share for present distribution.

The present distributions amount to £11,400 on the preference and £23,473 on the ordinary. The total dividends for year were thus £63,101, leaving to be carried forward to 1905, £21,877.

Private Supply: Average Prices per Unit Obtained.

1898 ..	6·22d.	1901 ..	4·54d.	1903 ..	3·72d.
1899 ..	5·16d.	1902 ..	4·04d.	1904 ..	3·25d.
1900 ..	4·09d.				

The following statements show the position of the company for the last four years:—

Customers and Lamps Connected (Motors included) Private Supply.

	Dec. 31, 1901.	Dec. 31, 1902.	Dec. 31, 1903.	Dec. 31, 1904.
Number of customers being supplied	10,618	10,988	11,197	11,558
No. (equiv.) of 8-c.p. lamps connected	549,175	574,158	640,685	727,961

On February 15th, 1905, there were 754,754 8-c.p. lamps (equivalent) applied for, out of which 737,397 were connected, and the customers numbered 11,619. The units sold during the year 1904, excluding public supply, were 16,320,238, as compared with 13,596,075 in 1903, 12,988,615 in 1902, and 11,526,951 in 1901.

Statement of Income for Four Years.

	Year ended Dec. 31, 1901.	Year ended Dec. 31, 1902.	Year ended Dec. 31, 1903.	Year ended Dec. 31, 1904.
Gross revenue (after deducting allowances to consumers)	£250,080	£250,667	£242,886	£256,838
Net revenue available for repairs and renewals, depreciation, reserve account, interest on debenture stock, &c., dividends and special charges ..	129,082	149,781	150,349	155,399

The directors have credited the first debenture stock premium redemption account with £1,221 from revenue for interest, and the amount at the credit of the redemption account at December 31st last was £52,081. They have also transferred the sums of £45,000 and £500 from net revenue account to reserve account, thus raising the balance at credit of reserve account to £256,758, in addition to which there are first debenture stock premium redemption fund, £52,086, and amount carried forward to 1905, £21,877; = £330,716.

The City of London Electric Lighting Co., Ltd. (extension of powers) Bill has passed Standing Orders, and will be introduced into the House of Lords. The directors decided to take over the East London and Lower Thames Electric Power Bill on behalf of this company, but as the Bill could not be promoted by the company itself, owing to the insufficiency of the Parliamentary notice, the directors agreed to their names being inserted as promoters and first directors. This Bill has also passed Standing Orders, and will be introduced into the House of Lords. Several Bills are being promoted in this session of Parliament which may affect this company to a certain extent, and the directors are taking such steps as are necessary towards safeguarding the company's interests.

Kensington and Knightsbridge Electric Lighting Co.

Lieut.-Col. R. E. Crompton, C.B., presided on February 23rd, at 148, Brompton Road, S.W., over the eighteenth annual ordinary general meeting of this company.

In moving the adoption of the report, the Chairman said that he thought he could say with some confidence that at no time during their 18 years of existence had the state of their affairs been so satisfactory as it was at the present time. When last year he told them that it was necessary to make considerable reduction in their prices to the public, he said that it was not reasonable to expect that they would earn the same profit as in that year. He was glad, however, to say that he was mistaken in that. The average price received per unit had fallen from last year's figure of 4·25d. to an average price of 3·9d. per unit. That reduction amounted to about 9 per cent., and from it their consumers had benefited by practically having handed back to them a sum of £4,000 during the nine months in which the reduction had been in operation, and they would get a further sum of about £1,500 in the present quarter. In spite of that, they had been able to pay the shareholders a distribution practically equal to that of last year. That satisfactory result had been obtained partly by increased economy of working at their generating stations, and partly by the natural reduction in the distribution of the fixed expenses which followed on spreading them over an increased output. The high position which he had claimed for the company in regard to economical management had still been maintained. They were taking now about two-thirds of their supply from the Wood Lane works, and they were therefore greatly interested in the economical working of those works. In order to facilitate that as much as possible, the company had adopted a progressive policy by adding to the amount of accumulator plant which they used, thus enabling them to work the plant at Wood Lane for longer hours, and they had been endeavouring, with some success, to persuade the company who worked with them as their partners at Wood Lane to follow their example by similarly increasing their accumulator plant. When that was done, the Wood Lane works would receive full advantage from working the plant for long hours, so that he hoped next year to show that the cost of supply from Wood Lane had been still further reduced. However, even under the existing circumstances, during the winter months, the Wood Lane costs were record costs for the London district. He was glad to say that the increase in the use of accumulators had been attended by no ill results in the way of increasing their maintenance charges; on the contrary, their accumulator plant had been thoroughly maintained, and was in very perfect order. While on the subject of the maintenance of their plant, which was a matter of extreme importance, he must refer to his last year's remarks. He then stated that the board had continued the policy, which they believed to be a sound one, of spending liberal sums on maintenance. From personal inspection he was able to state that their plant was in every respect in the best condition. He knew of no weak spot, but in spite of liberal expenditure on maintenance, their accounts showed that the works cost of producing their electricity was actually 5 per cent. lower than it was last year. In regard to other items of the accounts, they were still groaning under the burden of municipal rates. He must call their attention to the amount set aside on depreciation account for this year, which had increased from £9,285 last year, to £10,967 in the current year, an increase which they must consider a satisfactory feature. Their renewal and depreciation fund altogether now stood at the satisfactory figure of £56,500. There was only one item in which there had been an increase, and this was in maintenance, due to the fact that the directors thought it only just and fair to increase the salaries of certain members of the staff, for they considered that the present condition of the company was largely due to the efforts of the staff. Turning to the future outlook, he considered it, on the whole, satisfactory. It was true that during the year the gas companies had bestirred themselves by holding an exhibition, and, no doubt, this had led to some increase in the use of gas, but he felt confident that by adopting similar means of calling the attention of the public to the improvements in the utilisation of electricity, they could maintain their progressive increase of output at the same rate as in the past. He would point out that the price they charged to their customers depended entirely on the number of hours during which they were able to utilise their plant. So long as electricity was only used for lighting purposes, the use of their plant was limited. In other places electricity was used in the daytime for motors and other uses, but that was not the case in their district. In their district they got a very small day load, from the fact that there were very few dark basements, as was the case in other parts of London. Unfortunately, Londoners were very conservative, and in their district they had not many industrial users. Motors were, however, on the increase, and doubtless they had noticed the rapid increase in the

use of vacuum cleaning apparatus, which, in a large number of cases, was driven by electric power. They looked for an increase in the use of power in the cleaning and ventilating of houses and in other ways, and with an increase in the day load, they looked forward to decreasing the price to their consumers, and at the same time maintaining their dividend. Considerable misapprehension existed as to the cost of electricity owing to the statements made in connection with projected power schemes that it could be produced at as low as 1d. per unit. People who read those statements did not appreciate the fact that this was for power purposes only. They proposed to again pay a dividend of 10 per cent. with a bonus of 2 per cent. In the current year they would have to make further reductions, and as that would doubtless continue, the board felt it was better to divide their profits in this way.

Mr. Roger Wallace, K.C., seconded the motion.

Mr. Makins congratulated the board on the progress of the company, but said the reduction in the price had not yet come his way.

The report was adopted, and the resolution declaring the dividend was carried on the motion of the chairman, seconded by Sir H. Bliss.

Mr. Tufnell proposed that the remuneration of the directors be increased from £1,000 to £1,750 a year, and after a short discussion, raised by Mr. Makins, as to whether the increase was not somewhat excessive, the motion was carried.

The usual votes of thanks terminated the proceedings.

National Telephone Co.

Sir Henry Fowler, M.P. (chairman), presided on Tuesday at Hamilton House, over the thirty-fifth ordinary general meeting of the above company.

In proposing the adoption of the report, the Chairman said the figures were satisfactory as contrasted with the figures of the corresponding period, but the half-year was not a true test. To get a true test they must take the whole of the year. The gross income for 1904 was £2,018,979, as against £1,835,343 in 1903, an increase of £183,136. Post Office Royalties were £185,937, an increase of £17,688. The working expenses were £1,154,696, an increase of £117,000, and a considerable portion of this was due to increases in rates and taxes. The net profit was £678,346, an increase of £47,450. After payment of the usual dividends, they would carry £215,000 to reserve, which was a considerable advance on what they did in 1903. As they knew, he had always advocated the putting away of £200,000 to reserve, and seeing that they had spent a considerable amount on capital expenditure, he felt an increase to the amount of the reserve was justified. In 1904 their stations were increased to 315,829, as against 277,589, and their unexecuted orders at the present time were 9,490, as against 9,943 last year. The staff had increased during the year from 12,977 to 13,844, and the messages, calculated in the usual way, were 995,671,644, which was 10 times the number of telegrams sent. The average receipt per message was less than ½d. The most important matter in the report was of course that which stated that the board, after protracted negotiations, had arrived at an agreement with the Postmaster-General for the sale to him on December 31st, 1911, of the undertaking of the company, which agreement was subject to the approval of Parliament. Those negotiations had lasted for 12 months, and had constantly occupied the attention of the board, who had given their best ability and consideration to them. He was expressing the opinion of the board when he said that during the whole of the negotiations they were indebted to Mr. Anns, the secretary, Mr. F. Gill, the engineer-in-chief, and Mr. W. Gaine, the general manager, for the great assistance they had rendered. As the shareholders were aware, the company died on December 31st, 1911, so far as the carrying on of its licensed business was concerned. Over and over again the board had been asked what they proposed to do, but they were not in a position to say anything before 1904, because up to the end of 1904 the Government had the power to compulsorily take their business whether they liked it or not. Parliament had determined that telephonic communication should be under the control of the Postmaster-General, and it was useless to argue whether that was a wise decision or not. Three years ago the Postmaster-General entered into an agreement with the company by which it was agreed that the Post Office should take over the London business of the company in 1911. He felt that after the amplest consideration both in Parliament and the Press, the general feeling was that it was a wise agreement in the interests of all. That agreement had been in operation for three years, and had worked satisfactorily both for the public convenience and in the interests of the shareholders of the company. At the end of December last the Post Office had 22,181 exchange stations, but during the same period the company had increased its stations by 22,950, which showed that a further supply of facilities was needed to meet the public demand. In London the company had 71,417 stations, and London was between one-fifth and one-fourth of the company's whole business. Practically the principle of the fresh agreement entered into was the extension of the London agreement to the whole country. The principle was, that at the end of 1911 the company should be paid the fair market value of the plant at that time. If there was any difference of opinion, the matter would go to arbitration. The agreement would go before a Select Committee, and would be subject to the approval of Parliament, and he was prepared to leave it to the independent decision of Parliament. He might say that the authorised capital of the company was £10,500,000, of which £9,189,593 was issued. The expenditure of capital had been £10,840,780, the difference between the two amounts being accounted for by the reserve fund which was invested in the business. If the agreement became operative, the opinion of counsel would be taken on the rights of the different classes of shareholders and the decision communicated to them.

Mr. Geo. Franklin seconded the motion.

Replying to a number of questions raised, the Chairman said the cost of the central battery system was heavy, but under Mr. Gaine it was being extended in London. They hoped to extend their business considerably, but as to how the capital necessary for this would be raised was a matter for further consideration. He could not go into details as to the possible effect of the agreement on the repayment of the capital.

The report was adopted.

Charing Cross and Strand Electricity Supply Corporation.

Mr. W. F. Fladgate (chairman) presided on Wednesday at the offices, 60, St. Martin's Lane, over the annual general meeting of the above company.

In moving the adoption of the report, the Chairman said this was the eighth year he had met the shareholders, and during that time their progress had been very great indeed. Eight years ago, they only supplied a few more lights than the addition which took place last year. The increase in the whole of their lamps during the year was 132,700 lamps, a record for any company, except the one they themselves established in 1903, of 146,710 lamps. Their grand total in all their districts was 710,744 lamps, and the result of that figure was that they were now the fourth company in London in point of supply. Of these additions 73,752 lamps had been added in their West End districts, making a total for these districts of 407,663. There had been a certain expenditure of capital, the most important being on the erection of a new station in the Green Park, which enabled them to supply the Mall and other roads, and was a most important help to them in dealing with the extreme western portion of their district. On the capital account the sum of £237,411 had been spent in the City. With regard to the revenue account, the figures were more satisfactory than formerly. The cost of coal had been about one-tenth of 1d. less per B. of T. unit than last year. £11,000 had been written to depreciation account as against £10,000 last year, and that was considered sufficient seeing that the plant was well kept up, and £9,000 had been expended during the year on repairs to mains, &c. The revenue from sale of energy had increased from £110,000 to £122,877. It was proposed to pay a dividend of 8 per cent., and carry forward £10,283. The total reserves of the company now amounted to £223,377, as against £202,788, or 23 per cent. of the actual expenditure in the West-end. It was true that these reserves were employed in the business, but he could not work it otherwise. The chairman proceeded to deal with the proposed agreement between the company and the Charing Cross and City Electric Co. When they decided to go into the City, they formed a construction company, called the Charing Cross and City Electric Co., to carry out the work. That contract company was formed by the Charing Cross and Strand Co., and the whole of the benefit came to the company. The Charing Cross and Strand Co. lent the contract company £200,000 to start the works, and this was the £200.000 represented in the balance-sheet as share capital of the contract company. Works to the extent of upwards of £1,000,000 had been done under contracts entered into in 1900 and 1901, and for practical purposes the important works had been finished. That being so, it was not considered right to continue the work of the construction company, and it would be better to complete all the accounts before them. Mr. Fladgate went at great length into the figures proposed to be dealt with, which simply amount to paper entries, and will result in loans, investments, &c., to the City undertaking being wiped out of the accounts, and the whole of the share capital in the City undertaking, viz., £350,000 standing in the books of the Charing Cross and Strand Co. as an asset. The City undertaking was making steady progress, and 58,968 lamps had been added during the year, making upwards of 300,000 lamps connected during the few years they had been in business. To sum up the position, he might say that on both undertakings their capital expenditure was about £2,167,000, and this was represented by nearly £1,000,000 spent on 580 miles of mains, and a little over £1,000,000 spent on stations, buildings and machinery. It had been necessary for them to spend this large amount of capital, and it might be asked when they were going to cease spending. If ever they actually ceased to spend, they would cease to work, for it would always be necessary to spend a certain amount on capital account. Last year he stated that 20 per cent. of the capital expenditure was at present unproductive, and he might illustrate that by reference to the Bow station. That station had a capacity for 800,000 lamps, and at present it supplied the equivalent of 200,000 lamps for the West End, and 300,000 lamps to the City. To bring up their City sub-stations to deal with the remaining 300,000 lamps which the Bow station could supply, would only need the expenditure of a further £100,000.

Mr. G. H. Brougham Glasier seconded the motion.

Replying to questions raised by shareholders, the Chairman said that practically the whole of their reserve fund was invested in the City undertaking, and if that undertaking was taken over by the City Corporation in 1913, 4 per cent. on the whole of the expenditure would have to be paid by the corporation, whether it had been earned or not. As to depreciation on the City undertaking, with regard to a large amount of the machinery, the guarantees of the makers had not run out. It was a young undertaking, and they could not yet afford to provide for depreciation, but they had the matter in mind.

The report was then agreed to, and the retiring directors and auditors were re-elected.

The Chairman moved a resolution confirming the agreement entered into between the Charing Cross and City Electric Co., Ltd., and the Charing Cross and Strand Electric Supply Corporation, and this was seconded by Mr. Glasier, and carried.

Replying to a question, the Chairman said the whole question of fresh capital was under the consideration of the board.

An extraordinary meeting was afterwards held, when the following resolutions were adopted:—

1. "That the Bill submitted to this meeting intituled—A Bill to confer further powers upon the Charing Cross and Strand Electricity Supply Corporation, Ltd., be, and the same is hereby, approved subject to such additions, alterations or variations as Parliament may think fit to make therein, and the directors shall sanction.
2. "That the name of the Corporation be changed to the Charing Cross (West End and City) Electricity Supply Co., Ltd."

The Chairman said the object of the Bill was to enable them to supply electricity for power. There was a big company bringing a Bill before Parliament, which he felt was quite unnecessary, for the existing companies could supply all that was required.

W. T. Henley's Telegraph Works Co.

The directors report that during 1904 a net profit of £46,521 has been made. After payment of directors' and auditors' fees, debenture interest and income-tax, and making the usual allowance for depreciation of buildings, plant, machinery, &c., there remains £38,264, making, with £27,585 brought forward from last year, a total of £65,849. The directors have transferred £1,000 to the debenture redemption sinking fund, and they recommend the payment of a dividend on the ordinary shares at the rate of 15 per cent. (less income-tax), including the interim dividend of 5 per cent. paid on September 1st last. These payments will, together with the preference dividend for the year, amount to £39,337, leaving a balance of £26,512 to be carried forward. The dividend warrants for the ordinary shares will be posted on March 6th, 1905. The directors record with deep regret the death of their esteemed colleague Sir Henry Morton Stanley, G.C.B.; they have elected Mr. B. T. Finch, C.I.E., to fill the vacancy.

London Electric Supply Corporation.

Mr. R. H. Benson occupied the chair at the annual meeting of the above company, held on February 23rd at Winchester House.

The Chairman, in moving the adoption of the report, referred to the absence of the Earl of Crawford, who, he said, was one of the Old Guard, and would have been gratified to have been present when the company paid its first dividend. With even more regret he deplored the fact that Lord Wantage, but for whose courage and unselfishness the shareholders would have lost all their money, had not lived to reap his reward. The accounts came out almost exactly as he predicted a year ago. The units sold had risen from 4,102,099 to 10,531,785, while the cost per unit sold declined from 2·39d. to 1·21d. The number of lights had risen from 219,364 to 238,582. The gross revenue had risen from £77,190 to £118,395, and the net revenue from £36,177 to £65,333. With regard to the cost of production, the figure of 1·21d. was the lowest of any London company that had so far published its accounts, and upon that he would ask them to express a word of encouragement to the staff, and especially to Mr. Partridge, the chief engineer; Mr. Burstall, their consulting engineer; Mr. Carter, the secretary; and last, but not least, to the managing director, Mr. Bain. Mr. Partridge and Mr. Bain were part of the old guard, and had given the best years of their lives to their service, and Mr. Carter had also been with them for many years. The extension of their lighting business kept on in its old steady way; but what had brought them to their present satisfactory position was the development in the demands for power in bulk, which gave employment to the plant when it would otherwise be idle, and so reduced the average cost. Their principal customer was the London County Council, but that contract would not last for ever. The intention was, that it should last until the L.C.C. had put up their own station, which would be one or two years more. The contract was a satisfactory one on both sides, and such contracts sometimes made life friends. Their position at Deptford was unique and the supply of power cheap, and they could trust the board not to lose a good customer if they could help it. Beyond that, they anticipated a steady increase in the general demand for power in bulk. The net result of their operations was that they had £33,403, after paying the dividend on the preference shares. Their first duty was to create a reserve account against contingencies, of which the chief was antiquation of plant, and so they proposed to place £5,000 to contingency account. Their next duty was to add to their general reserve fund like their neighbours, in view of the fact that they were purchaseable by the local authority in 1931. Although they had written off £227,565 in times past, making their £5 shares only £3 nominal, yet they had got to pile by reserves over and above the ample sums for renewals and maintenance which they annually charged against revenue account. They, therefore, proposed to put £18,500 to reserve, bringing that account up to £25,000, and then they would pay 3 per cent. on the ordinary shares, and carry forward £2,000. As to capital expenditure last year, he told them they expected to spend £50,000; and that had been done, and this year he expected that they would have to spend £55,000. They were putting up two new stations for the supply of continuous current for power—one in Deptford and the other in Lambeth. Parliament in its wisdom had decided on there being one competitor in each district, and seeing that they were purchaseable by the local authorities, he thought they were entitled to look to Parliament for protection against further competition. They were ready to give the public in their area all the service they wanted, and at competition prices, and they were determined to defend themselves against any invaders, whether they came from the north, south, east, or west. He said that in all seriousness with regard to the heterogeneous mass of Bills which had been brought in during the present session of Parliament. Not only were they called upon to defend themselves from new companies, but also from the poaching of fellow electric lighting companies. He felt that this attempt at poaching was dangerous, because dissensions amongst the London electric lighting companies were other people's opportunities. He had reasons for feeling that they need not be so anxious about it as some of their neighbours. If pushed too far it might become their opportunity, and the board were not going to tie their hands until they were assured that the shareholders' interests were fully protected. The first condition to that was that they must be financially strong both in cash and credit, and he drew their attention with some satisfaction to the strong cash position of the company and to their unissued capital powers, which were easily available now that trade had improved.

Sir W. H. Preece seconded the motion.

Mr. Makins called attention to the fact that the reserves were invested in the business, and asked how that would be dealt with when the time for purchase came?

Mr. Rucker also alluded to the reserve fund, and advocated the investing of the reserve funds in securities outside the business.

Replying to these and other questions, the Chairman said that the capital expenditure in respect of the supply to the L.C.C. was all made last year, and the £55,000 he had alluded to was required for the ordinary development of the business. In his opinion, they were right in investing the reserve in the business. They had got to spend money all the time in the business with the object of returning at least £3 per share when the time for purchase came.

Mr. Bain (managing director) made his usual statement as to the progress of the company during the year, and said that of the £49,000 of capital spent rather more than £20,000 was used for the completion of the new condensing plant, £6,000 for new engines, £4,000 for sundry new plant in connection with these engines for condensing, and the remaining £12,000 for new mains. They had completed the new trunk main between the Blackfriars station and Trafalgar Square station, *vid* Westminster Bridge. The average price received per unit still showed a decrease, accounted for by the large increase in the power supply. If they left out of consideration the supply to the L.C.C. the average price received per unit sold decreased from 4·5d. in 1903 to 4·1d. in 1904. The decrease was likely to continue. The cost per unit showed a decrease of no less than 50 per cent., viz., from 2·39d. during 1903 to 1·21d. last year. The decrease was owing to two causes. One was the large increase in the units sold, and the other was the economy effected by means of the new condensing plant. The principal saving had again been in coal. The consumption during 1904 was 29,000 tons as compared with 14,000 tons in 1903, but while in 1903 they sold 4,100,000 units, last year they sold 10,500,000 units, so that the saving in the coal consumption had been 21 per cent. The cost of the coal was ·51 per unit as against ·79 per unit, and the reduction was principally due to the fact that they were able to burn a cheaper coal owing to the new condensing and other plant. Their supply continued to give every satisfaction, and they were endeavouring, by every possible means, to increase the demand for power purposes. The prospects for the current year were distinctly favourable, for the units sold and lamp connections already showed a considerable increase over the corresponding period of last year.

The report was then carried, and the election of directors, &c., followed.

Telegraph Construction and Maintenance Co.

Sir Robert Herbert presided at the meeting of this company, held at the offices in Old Broad Street, E.C., on Tuesday. He said that it had been a very lean year with them, a circumstance to which they were unaccustomed, after having three or four years of very hard work. They had, however, been able to scrape together legitimately a dividend of 15 per cent., which he trusted was acceptable under what he hoped were the temporary circumstances of depression of 1904. After running over some of the principal figures in the accounts, he said that the net profits were £50,785 as against £115,580. They had been doing a good deal of work in maintaining and repairing cables of other companies and completing short and important lengths of cable, but they had had no gigantic work such as they had had to do for three years running. They were carrying forward a substantial balance of over £100,000, and would thus make preparation for the possibility—though he trusted it was not at all likely to be a probability—of their not having important work to do next year. They would certainly have a great deal of routine work. The new cable steamer *Cambria* was greatly admired as a workmanlike ship, likely to be worked at a much lower cost per ton than any of their previous vessels. She carried a very large amount of tonnage of cable. They had parted with the *Britannia*, and this new vessel would take her place with economy and efficiency. He hoped that he would meet them under more gratifying circumstances before long.

In reply to questions, the Chairman said with reference to the possible cable between Denmark and Iceland, which would be put through by the Great Northern Telegraph Co., that they had heard of no movement with regard to its construction up to the present time. He had not mentioned the new Atlantic cable, because the arrangements for it were not absolutely completed, but he had plea-

sure in informing them that they had made arrangements for the construction of that cable, and they would be putting it in hand before long. They had got the business to do, and would do it before the end of the year. The expenditure on the ships and renovation of factories came out of reserve funds, but a small proportion was charged against revenue.

The report was adopted, and a vote of thanks to the board and staff was passed. The chairman, in responding, paid a tribute to the excellent work done by the sea-going staff.

Imperial Tramways Co.

Sir G. White presided at the annual meeting, held on Saturday at Bristol. He said that the report was of a completely satisfactory character. The Middlesbrough, Stockton and Thornaby Electric Tramways showed a net profit of £16,564, against £16,353, in addition to which they had added £1,400 to the Middlesbrough renewal fund. They had obtained powers to continue their existing system at Middlesbrough, and to run through the populous manufacturing districts of North Ormesby, South Bank, Grangetown, and Eston. The new Act included authority to convert from single to double the lines adjacent to the Stockton racecourse. After referring to the amount of stock the company held in the London United Tramways Co.—5 per cent. cumulative preference shares—he said that though, consequent upon heavy outlays upon capital account, the good round dividend of 6 per cent. fell short of that for 1903, he congratulated the directors of the London United on having made a profit of £120,000 last year, against £103,000 in 1903—about a fifth of which profit accrued to the Imperial Co. in preference dividend. The net profit of the Imperial Co. for the year was £41,655, and after the 6 per cent. dividend on preference capital it was proposed to pay a dividend at the rate of 10 per cent. on the ordinary stock, making 9 per cent. for the year. The company's reserve fund now amounted to £121,871, apart from the ordinary share dividend fund of £40,000. The report was adopted.

Bournemouth and Poole Electricity Supply Co.—The directors recommend a dividend on the ordinary shares at the rate of 7 per cent. per annum for the year ended December 31st, 1904.

Northallerton Electric Light Co. — The annual meeting of the company was held on 22nd ult., Mr. John Hutton, M.P., presiding. The report mentioned in our last issue was adopted.

Metropolitan Electric Supply Co.—The directors recommend a final dividend for 1904 of 11s. per share, making a total distribution for the year of 20s. per share, or 10 per cent., carrying forward £9,000.

County of London Electric Supply Co.—After placing £20,000 to reserve for depreciation and carrying forward about £5,000, the directors have decided to recommend a final dividend on the ordinary shares at the rate of 5 per cent. per annum, less tax, for the half-year ended December 31st, making 4½ per cent. for the year.

Underground Electric Railways Co. of London.—An extraordinary general meeting has been convened for March 2nd, for the purpose of passing resolutions authorising the directors at their discretion to raise or borrow or secure the payment of any sum or sums of money for the purposes of the company, not exceeding £4,000,000, in addition to the amounts which they are at present authorised to borrow, &c.

Blackpool and Fleetwood Tramroad Co.—It was stated at the company's meeting at Manchester on February 23rd, that the company would go on with their appeal with regard to the rating of the line, which is claimed to be a railway, and, therefore, amenable to the reduced railway rating. The company intended, it was further stated, to take the appeal to the House of Lords if necessary, and if they succeeded it would mean a saving of £800 per annum.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a Special Settling Day in, and to grant a quotation to—

Baker Street and Waterloo Railway Co.—Script certificates to bearer (fully and partly paid) for £500,000 4 per cent. perpetual debenture stock.

and to allow the following securities to be quoted in the Official Lists—

British Aluminium Co., Ltd.—20,000 4 per cent. funding certificates of £5 each.

Metropolitan District Railway Co.—Further issue of £200,000 4 per cent. perpetual debenture stock, 1903.

General Electric Co.—The transfer books of the 4 per cent. Debenture Stock of this company will be closed from 18th to 31st inst., both days inclusive.

STOCKS AND SHARES.

Wednesday Evening.

With the entry of March Stock Exchange markets are found in a more buoyant condition than they have been in at any time, so far, this year. The only real menace to the freshly-awakened confidence that leads investors to the markets, lies, in our view, in the eagerness of borrowers to take advantage of what the Liberal party might call the flowing tide. At present, the public are taking new issues readily enough, but this appetite will probably be easily satiated, and one or two fiascos in the region of new Loans might lead to a check upon investment stocks all round. But just now the optimism continues, and again our lists display a series of rises remarkable in their number for sections that appeal almost exclusively to classes outside those of the speculatively inclined.

Most of the dividend announcements and reports of the Electric Supply companies are now available, the latest contributions of the former kind being those of the County and the Metropolitan undertakings. In both cases an increase is shown on the full twelvemonth, the County's 4½ per cent. comparing with 4 per cent., and the Metropolitan's 10 per cent. being 1½ per cent. better than the 1903 distribution. Metropolitan shares rose to 19 on the announcement, and County's went up ¼ to 9⅜, the Preference being also ¼ better at 12½. The Notting Hill report tells of substantial progress, and it will be well if the Founders' shares can be disposed of in some equitable way. Most of the dividends deducted from electric supply quotations last week have been wholly or partly recovered, *e.g.*, Chelsea Ordinary, Charing Cross, Smithfields, Westminsters and Kensingtons. Some irritation is felt at the way in which the Kensington Co. presents its accounts, and as the officials themselves appear to offer no objection to a change, it is difficult to see why the figures cannot be shown in a manner more easy to be understanded of the people. Urban Ordinary put on $\frac{1}{16}$ at 5½.

London Electric Supply shares at 2$\frac{13}{16}$ are $\frac{1}{16}$ up, plus 5s. for the dividend, while the price is now *ex*. The Preference, too, rose to 6. The Miscellaneous section remains decidedly good, Callender's being another ¼ up at 11, India-Rubbers 10s. harder at 16½, and Henley's Preference having recovered the dividend of 2s. 3d. per share. Cromptons, exceptionally, are duller at 2¼, but Westinghouse Preference have improved to 2$\frac{13}{16}$. Babcock & Wilcox advanced to nearly 4½.

Notwithstanding the somewhat singular duet of approval from the financial papers upon the London United Tramways report, we have no hesitation in again advising sales of the company's shares, Ordinary and Preference; the Debenture stock may possibly be well secured. The *Pall Mall Gazette* elaborates the counsel we gave to this effect last week, and rightly draws attention to the lack of provision for the future that is shown by the trifling carry-forward, the bagatelle of £5,000 styled "Reserve Fund," and the absence of any writing off for depreciation. Such a procedure as this can have but one ending if it be persisted in, and even at the risk of passing dividends on both classes of shares the directors should seize every opportunity for making the provision alluded to. The Preference shares are dull at 10¼, but, we understand, will be supported—for a time at any rate—at about that price, and the Debenture stock stands at 103, a fall of 1 per cent. Dealings in both kinds are inclined to become very nominal.

Debenture stocks are being picked up in the Traction market with some eagerness, and British Electric First Debenture shows a point rise at 122. Perth Electric (W.A.) Debenture is better at 106½, and there is a fair amount doing in Bath Electric 4½ per cent. Debenture about 102. The company's Preferred Ordinary shares are $\frac{13}{16}$, and the 5 per cent. Preference stand at a pound. Anglo-Argentines advanced a trifle to 8¼ and the Preference to 5⅞. Calcuttas are slightly firmer at 8$\frac{13}{16}$.

Electric Railway issues mark little quotable change. City and South London at 45½ is the fraction to the good, although the traffics give the stockholders but small encouragement. Central London Deferred is a point better at 83, and the Ordinary rose 1½ to 94½; while Districts have got to 42 again, Metropolitan Ordinary is 96, Baker Street and Waterloo Debenture 2½ premium, Great Northern and City Preferred 6¼.

At the National Telephone meeting on Tuesday, Sir Henry Fowler discreetly refused to prophecy whether there would be enough money in 1911 to return the capital in full. The market's valuation of Deferred stock has increased to 112½, a rise of 1½, and the Preferred regained a point of its last week's drop. At 5½ the Third Preference are ¼ better, and ⅛ rise takes Chili Telephone shares to 6⅝, Oriental Ordinary improved $\frac{1}{16}$ to 1$\frac{3}{16}$, Telephone securities having come strongly to the fore.

In another long string of rises amongst Telegraph issues, the most noticeable feature is the consistent advance in West India and Panama varieties. The first Preference has again improved 10s., to 9¼, the Second Preference ¼ to 9 (which makes a £2 rise in a month), and the Ordinary $\frac{1}{16}$ to $\frac{1}{8}$. Eastern descriptions are also firmer, Eastern Ordinary and Preference to the extent of a point apiece, and Eastern Extension shares ¼ to 14¼. The Anglo-American Telegraph Co.'s trio advanced, Great Northerns added £1 at 31½, and West Africans 15s. at 8¼, the latter being, in consequence, of renewed attention to the Gold Coast. Globe Ordinary have not moved from 10⅛, but at 14⅛ the Preference are 2s. 6d. better.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1902.	1903.	1904.	Closing Quotations Feb. 22nd.	Closing Quotations March 1st.	Business done week ended March 1st. 1905. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	99 —102	99 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	1½— 2½	2½— 2⅝	2⅝	2½
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,950 Red.	100	..	..	..	— —	60 — 70		
788,840	Anglo-American Telegraph	Stock	80/6	61s.	22½	59 — 61 xd	60 — 62	60½	60
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5½%	106 —108 xd	107 —109	108½	106½
3,105,580	Do. do. do. Deferred	Stock	1/-	2s.	Nil	13½— 14	14½— 14½	14⅝	18⅜
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	..	6⅝— 6⅝	6½— 6⅝	..	..
18,888,800$	Commercial Cable	$100	8 %	..	..	170 —190	170 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	96 — 98	97 — 99	98	97½
16,000	Cuba Telegraph	10	6½%	5 %	..	8⅞— 9½	8⅞— 9½	9⅛	..
6,000	Do. 10 % Pref.	10	..	..	..	17 — 18	17 — 18	..	..
12,981	Direct Spanish Telegraph, Ord.	5	..	..	..	3⅜— 3⅝	3⅜— 3⅝	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	8 — 8½	9 — 8½	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	100 —102	100 —102	..	..
60,710£	Direct United States Cable	20	3½%	3 %	..	11½— 11½	11½— 11½	11⅛	11⅛
78,500	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	100 —102	100 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	140 —143	141 —144	144	140½
1,955,555	Do. 8½ % Pref. Stock	100	..	..	..	88 — 90	89 — 91	90½	89
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	107 —109	107 —109	108	107
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	..	13⅞— 14½	14 — 14½	14⅛	14
250,000£	Do. 4 % Deb. Stock	Stock	..	..	..	104 —106	104 —106	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	100 —102	100 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —102	101 —103	..	..
180,227	Globe Telegraph and Trust	10	£3 16 7*	5½%	..	10½— 10⅝	10½— 10⅝	10½	10½
180,042	Do. do. 6 % Pref.	10	..	..	..	13⅝— 14½	14 — 14½	14⅛	14
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	15 %	..	30½— 30⅝	31 — 32	31½	31
50,600	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	100 —102	100 —102	..	..
17,000	Indo-European Telegraph	25	10%	10 %	..	46 — 48	46 — 48	..	..
72,680	Monte Video Telephone Co., Ltd., Ord.	1	3 %	3 %	..	⅛— ⅜	⅛— ⅜	..	..
1,988,888	National Telephone, Pref. Stock	100	6 %	6 %	6 %	110½—111½	112 —113	112⅞	111⅜
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	105 —107	106 —108	107⅛	106
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	3½%	5½— 5⅝	5½— 5⅝	5⅝	5⅝
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	4 %	98 — 100	98 —100	100	99
689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	..	103 —105	104 —106	104½	104
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6½%	..	1⅛— 1⅜	1⅛— 1⅜	1⅜	1⅛
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1⅜— 1⅜	1⅜— 1⅜	1⅜	1⅛
100,000	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	98 —101	98 —101	..	..
11,889£	Reuter's	8	5 %	..	..	7 — 7⅛	7⅛— 7⅜	..	..
5,808	Submarine Cables Trust	Cert.	..	..	..	123 —126	123 —126	..	..
55,000	United River Plate Telephone	5	7 %	..	..	7⅛— 7⅜	7⅛— 7⅜	7⅛	7⅛
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	5 — 5⅛	5 — 5⅛	..	..
179,947	Do. do. 5 % Debs.	Stock	..	..	..	106 —108	106 —108	..	..
15,809£	West African Telegraph, Shares	10	2 %	4 %	..	7⅛— 7⅜	8 — 8½	..	..
80,008	West Coast of America, 1 to 80,000 and 53,001 to 53,008	2½	..	..	..	⅞— 1	1/16— 1/8	..	..
150,000	West Coast of America, 4% Debs., 1 to 1,500 guar. by Brss. Sub. Tel.	100	..	..	..	99 —101	99 —101	..	..
267,980£	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	..	13½— 14	13½— 14	13⅞	13⅝
75,000	Do. do. 5 % Debs. 2nd series, 1908	100	..	..	..	101 —103	101 —103	..	..
400,000£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	102 —104	102 —104	..	..
86,891	West India and Panama Telegraph	10	..	..	..	⅜— ½	⅜— 1	⅜	⅜
84,668	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	8½— 9	9 — 9½	9½	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	8½— 9	8½— 9½	9½	..
60,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	102 —104	103 —105	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	4½— 5	4½— 5	..	..
10,000	Do. do. "A" 6 % Cum. Pref.	10	..	..	..	4½— 5½	4½— 5½	..	..
800,000£	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	98 —102	98 —102	..	..
100,000	British Electric Traction	10	8 %	..	..	9½— 9⅝	9½— 9⅝	9⅝	9⅝
100,000	Do. do 6 % Cum. Pref.	10	..	..	..	10⅝— 11⅛xd	10⅝— 11⅛	11⅛	10⅝
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	120 —122	121 —123	122½	122
	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	..	97 — 99	95 — 97	..	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	..	5⅜— 6⅛	5⅜— 6⅛	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	..	..	..	101 —104	101 —104	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	..	..	..	⅝— ¾	⅝— ¾	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	..	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	..	½— ⅝	½— ⅝	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	..	1⅜— 1⅝	1⅜— 1⅝	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	94 — 97	92 — 96 xd	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	79 — 82	79 — 82	..	..
85,000	Callender's Cable Construction shares	5	15 %	12½%	..	10½— 11	1⅛— 1⅛	11⅛	10⅝
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5⅝— 5⅞	5⅝— 5⅞	5⅝	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	105 —107	105 —107	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	..	92 — 94 xd	93 — 95	94½	94
494,098	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	..	101 —103 xd	101 —103	..	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	..	81 — 83 xd	83 — 86	83½	83
1,320,000	City and South London Railway	Stock	3½%	2½%	2½%	44½— 45½xd	45 — 46	46	44½
85,000	Crompton & Co., Nos. 1 to 85,000	5	6 %	..	..	2⅜— 2½	2⅜— 2⅝	2⅜	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	93 — 98	93 — 98	..	..
99,961	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,961	5	Nil	..	..	⅝— ¾	⅝— ¾	..	..
17,189	Do. do. "A" shares, 01—017,189	5	Nil	..	..	1 — 1⅛	1 — 1⅛	..	..
344,022£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	77 — 82	77 — 82	83	82½
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	79 — 84	79 — 84	..	..
112,100	lectric Construction 1 to 112,100	2	6 %	4 %	..	1⅛— 1⅜	1⅛— 1⅜	..	..
81,290	Do. do. 7 % Cum. Pref., 1 to 81,290	2	..	..	..	2⅛— 2⅜	2⅛— 2⅜	..	..
62,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 — 99	97 — 99	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	..	..	9⅛— 10	9⅛— 10	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	91 — 96	91 — 96	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	15 %	15 %	12⅜— 13	12½— 13	13	12⅝
200,000	Do. do. 4½ % Pref.	5	..	..	..	5⅜— ⅝	5⅜— ⅝ xd	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	111 —113	109 —111 xd	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	..	..	15⅛— 16⅛	16 — 17	16⅞	15½
350,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	102 —103	100 —103	..	..
87,500	†Liverpool Overhead Railway, Ord.	10	12½%	12½%	12½%	8⅝— 8¾	8⅛— 8⅜	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	9⅛— 10½	9⅛— 10	..	..
87,350	Telegraph Construction and Maintenance	15	20 %	20 %	15 %	34 — 36	34 — 36	36½	35½
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	102 —104	101½ —103½	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	92 — 94	92 — 94	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (April 21st, 1904.)

SHARE LIST OF ELECTRICAL COMPANIES (continued).— ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years			Closing Quotations Feb. 22nd.	Closing Quotations Mar. 1st.	Business done week ended Mar. 1st, 1905.	
		‡	1902.	1903	1904.			Highest.	Lowest
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	£	8 %	10 %	..	10½— 11	10½— 11	..	..
20,000	Do. do. 7 % Cum. Pref. ..	£	..	..	..	10½— 10¾	10½— 10¾	10½	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	105 —108	105 —108	..	..
50,000	Charing Cross and Strand Electricity Supply	£	10 %	8 %	8 %	8 — 8¼	7⅞— 8 xd	8⅛	..
70,000	Do. do. 4½% Cum. Pref. ..	£	..	..	..	5⅝— 5¾xd	5⅝— 5¾	5⅝	5⅝
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	£	..	..	..	4 15/16— 5 1/16	4 15/16— 5 1/16	..	..
40,000	Do. do. 1908	£	..	..	..	4⅞— 5 1/16	4⅞— 5 1/16	5 1/16	5 1/16
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	102 —104	102 —104	103¼	..
44,496	*Chelsea Electricity Supply, Ord.	£	4½%	5⅛%	6 %	6¾— 7⅛	7 — 7⅛xd	7⅛	6 31/32
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	108 —110	109 —111	109½	108
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	£	5 %	5 %	6 %	12⅝— 13	12⅝— 13	12⅝	12⅛
40,000	Do. 6 % Cum. Pref., 1 to 40,000	£	..	..	..	13⅛— 14	13⅛— 14	13 1/16	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	123 —127	123 —127	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	103 —105	103 —105	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	£	4 %	4 %	4½%	9¼— 9¾	9⅜— 10	..	..
30,000	Do. do. do. 6 % Pref., 40,001—70 ..	£	..	..	..	12 — 12⅛	12¼ — 12⅜	12⅛	12 7/16
400,000‡	Do. do. 4½% Deb. Stock	Stock	..	..	..	108 —111	109 —112	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	102 —104	102 —104	103⅜	..
70,000	Edmundson's Electric Corporation, Ord. Shares	£	7 %	7 %	..	6¼— 6½	6¼— 6½	6 7/16	6 7/16
70,000	Do. do. 6 % Cum. Pref.	£	..	..	..	6 — 6¼	6 — 6¼	6 7/16	6 7/16
800,000‡	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	106 —108	106 —108	108	..
21,000	Kensington and Knightsbridge Electric Ord.	£	10 %	12½%	12 %	18 — 18½	18⅝— 18¾	18⅝	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —104	102 —104	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	£	..	..	3 %	2⅛— 2⅜	2 3/16— 2 5/16xd	..	..
49,840	Do. do. do. 6 % Pref.	£	..	..	..	5⅞— 6⅛	6 1/16— 6⅛xd	6 1/16	6
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	98 —100	99 —101	100¼	99⅛
100,000	Metropolitan Electric Supply, 1 to 100,000	£	10	7½%	8½%	10 %	18½— 18¾	18⅞— 19⅛	19	18 13/16
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	£	..	..	..	5⅜— 5⅝	5⅝— 5¾	5⅝	..
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	£	..	..	..	110 —115	110 —115	112	..
460,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	96 — 98	97 — 99	98¼	99
260,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	..	..	..	97 —100	98 —100	99	98 3/4
10,852	Notting Hill Electric Lighting	£	6 %	6 %	7 %	14½— 15½	14½— 15½	..	..
59,000	Do. do. 4% 1st Mort. Deb.	100	..	..	..	102 —104	102 —104	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£	14½%	14½%	14½%	13⅞— 14½	13¾— 13⅞xd	13 7/8	13⅝
20,000	Do. do. do. 7 % Pref. 20,001 to 40,000	£	..	..	..	8⅝— 9	8¾— 8⅞xd	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	98 —100	98 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£	2½%	4 %	..	2⅞— 3⅛	2⅞— 3⅛xd	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	79 — 83 xd	79 — 83	..	..
65,000	South London Electricity Supply, Ord.	£	..	12½%	8 %	4⅛— 4⅜	4⅛— 4⅜	4 5/16	4¼
100,000	South Metropolitan Electric Light and Power Ord.	£	..	..	..	⅞— 1	⅞— 1	..	..
60,000	(Late Blackheath and Greenwich 7 % Pref.	£	..	..	..	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..
100,000	Dist. E.L.Co.) 4½% 1st Deb. Stock	100	..	..	..	107 —110	107 —110	109½	108⅝
80,000	Urban Electric Supply, Ord.	£	..	..	..	5 — 5⅛	5 1/16— 5 3/16	5⅛	5 1/16
80,000	Do. do. 5 % Cum. Pref.	£	..	..	..	5⅛— 5¼	5⅛— 5¼	5¼	5 3/16
200,000	Do. do. 4½% 1st Mort. Deb. Stock Red	100	..	..	..	105 —107	106 —108	106⅞	..
110,000	Westminster Electric Supply, Ord.	£	12 %	13½%	14%	1 1/16— 1 3/16	13 — 13⅛xd	13 1/16	13
28,141	Do. do. 5 % Cum. Pref.	£	..	..	..	6⅛— 6⅜	6⅛— 6⅜	6¼	6 3/16

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

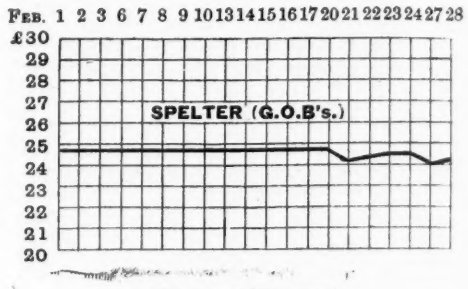
ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

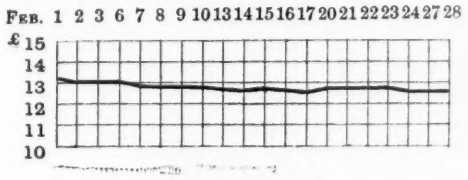
Locality.	Fortnight ended.	Receipts for the fortnight. £	* £	No. of wks.	Total to date. £	* £	Miles open.	*
Aberdeen	Feb. 25	2,116	+ 6	39	53,088	+ 5,761	10	..
Ayr	,, 25	341	+ 26	41	12,249	+ 672	..	..
Bath	,, 25	1,078	+ 89	8	4,264	+ 468	12½	..
Birkenhead	,, 26	1,863	— 12	47	49,184	— 818	13½	..
Blackburn	..	..	..	..	..	..	13½	..
Blackpool	,, 23	612	+ 54	47	45,912	+ 6,159	8½	..
,, —Fleetw'd	,, 25	364	+ 21	8	1,445	— 84	7½	..
,, —Lytham	,, 28	281	— 5	17	2,150	..	7½	+
Bolton	,, 26	3,196	+ 27	48	86,827	+ 480	25	..
Bournemouth ..	,, 22	1,744	+ 23	47	50,132	..	10·15	..
†Bradford	,, 18	3,881	+ 864	..	203,495	+ 29,545	54	..
Brighton	,, 26	1,426	+ 43	47	46,346	..	9½	..
Bristol	,, 24	8,694	— 5	..	..	..	23	..
Brit. Elec. Trac. Co.								
Airdrie	Feb. 17	396	— 10	7	1,363	— 10	..	..
Barnsley	,, 17	813	+ 8	,,	1,008	+ 29	..	..
Barrow	,, 17	375	+ 62	,,	1,215	+ 62	..	..
Birmingham (City)	,, 17	‡10,926	+ 459	,,	‡35,754	+ 776	3½	..
Birmingham (Mid.)	,, 17	‡3,522	+ 518	,,	‡11,263	+ 1,208	..	..
Devonport ..	,, 17	870	- 7	,,	2,981	— 93	5	..
Dudley—Sto'rb'ge	,, 17	1,552	+ 87	,,	4,936	+ 73	18⅝	..
Gateshead	,, 17	1,755	+ 48	,,	5,869	+ 101	10½	+ ¾
Gravesend, N'fleet	,, 17	377	— 47	,,	1,249	— 133	..	..
Gr'n'k, Pt. Glsgw	,, 17	803	+ 134	,,	3,494	+ 367	7½	..
Hartlepool ..	,, 17	484	— 3	,,	1,616	— 98	..	..
Kidderminster ..	,, 17	183	— 5	,,	613	— 7	..	..
Merthyr	,, 17	357	— 22	,,	1,167	— 97	..	..
Metropolitan ..	,, 17	‡3,999	+1,847	,,	‡13,046	+ 5,792	..	..
Middleton	,, 17	541	+ 67	,,	1,755	+ 159	..	..
Oldham — Ashton	,, 17	983	+ 24	,,	3,284	+ 27	8	..
Peterborough ..	,, 17	‡08	— 14	,,	679	— 47	..	..
Poole	,, 17	437	— 3	,,	1,454	— 27	..	..
Potteries	,, 17	3,278	+ 35	,,	10,999	+ 290	28⅝	..
Rothesay	,, 17	86	+ 10	,,	300	+ 25	..	..
Sheerness	,, 16	110	+ 17	,,	347	+ 50	..	..
Southport	,, 17	473	+ 18	,,	1,513	— 80	..	..
South Staffs. ..	,, 17	1,4?0	— 58	,,	4,331	— 325	21¾	- ¾
Swansea	,, 17	932	— 9	,,	3,052	— 35	5½	..
Taunton	,, 17	77	— 16	,,	267	— 47	..	..
Tynemouth	,, 17	842	— 65	,,	1,145	— 217	..	..
Weston-s-Mare ..	,, 15	54	+ 11	,,	176	+ 27	..	..
Wolverhampton D.	,, 17	707	+ 42	,,	2,294	+ 96	10⅜	+8
Worcester	,, 17	516	- 31	,,	1,693	+ 643	..	..
Wrexham	,, 17	197	+ 7	,,	620	— 27	..	..
Yorks. Wool. Dist.	,, 17	1,184	+ 166	,,	3,724	+ 423	6	..
Burnley	Feb. 25	1,849	+ 190	..	..	..	10⅜	..
Burton-on-Trent ..	,, 26	566	+ 1	47½	15,925	..	8¼	..
Bury	..	..	..	..	..	..	..	..
Cardiff	Feb. 18	3,650	— 66	46	93,578	+ 2,018	14	..
Carlisle	,, 25	273	— 55	8	1,162	— 202	..	..
Chatham and Dist.	,, 23	1,143	+ 156	8	4,427	+ 420	9·33	+ ·8
Colchester	,, 22	309	..	30	6,467	..	18½	..
Cork	,, 28	825	+ 76	8	3,876	+ 222	9·9	..
Darlington	,, 25	352	..	39	7,454	..	4·87	..
Darwen	,, 24	400	..	47	10,633	— 97	4·36	..
Dundee	,, 24	1,558	+ 20	39	..	..	4½	..
†Dover	,, 18	169	+ 7	7	1,162	— 63	3½	..
Dublin	,, 24	8,488	+ 127	..	34,499	+ 447	48	+ 1
East Ham	,, 25	1,279	+ 81	47	33,272	+ 1,814	6⅜	..
Glasgow	,, 25	27,528	+1,613	38½	558,587	+27,088	72½	+ 3
Gloucester	..	..	..	..	..	..	..	..
Halifax	,, 22	2,415	+ 301	47	67,386	+ 5,091	35½	+ 4
Huddersfield ..	,, 25	2,306	+ 137	47	63,445	+ 4,012	25	..
Hull	,, 25	4,054	+ 168	47	102,657	+11,074	18	..
†Ilford	,, 11	368	+ 30	45½	20,127	+ 1,009	6⅜	..
Ilkeston	,, 22	201	+ 39	47	6,210	..	3½	..
†Ipswich	,, 18	339	+ 24	46	21,387	..	10½	..
Isle of Thanet ..	,, 25	463	+ 10	8	1,847	+ 115	10½	..
Kirkcaldy	,, 22	386	— 46	..	..	..	..	..
Lan'kshire Trm. Co.	,, 23	1,229	+ 149	8	4,995	+ 364	8·6	..
Leeds	,, 24	10,629	+ 910	48	273,489	+15,659	89½	+8½
Leicester	,, 25	3,508	..	8	13,822	..	..	..
Liverpool	,, 18	19,802	+1,074	7	68,659	+ 2,156	103	..
L.C.C.	,, 11	25,417	+6,383	49½	575,479	+128,691	47½	+7½
Lowestoft	,, 25	238	— 14	..	..	..	4	..
Manchester	,, 25	22,629	+1,482	47	570,885	+25,853	137½	+12½
Newcastle	,, 25	7,067	+ 307	..	..	..	17	..
†Newport	,, 18	481	+ 43	20	10,105	+ 1,346	14½	+1½
Oldham	,, 26	2 683	+ 591	47	60,326	+ 4,696	22½	+4½
Plymouth	..	..	..	..	..	..	..	..
Portsmouth	,, 25	2,635	— 19	48	88,434	+ 6,429	14½	..
†Reading	,, 16	545	— 18	46	29,264	..	7½	..
Rochdale	,, 25	777	+ 587	48	12,608	..	14·8	+10½
Salford	,, 20	7,665	+ 429	45	188,024	+ 9,180	30	..
Scarborough ..	,, 18	128	..	7	462	..	3½	..
Sheffield	,, 26	8,686	+ 311	48	222,710	+ 6,003	84½	+1½
Southampton ..	,, 24	1,557	— 143	47	45,024	— 2,636	16½	..
Southend-on-Sea ..	,, 22	441	— 4	47	16,146	+ 1,570	6½	..
Stockport	,, 17	863	+ 118	46	25,064	+ 8,486	11½	+1
†Sunderland ..	,, 19	1,079	+ 18	47	57,983	+ 1,472	21	+1
Tyneside	,, 22	665	+ 106	8	2,477	+ 317	8·9	..
†Warrington ..	,, 23	290	+ 22	47	15,013	+ 573	7½	..
West Ham	,, 23	1,128	..	52	50,496	..	9·8	..
Wolverhampton ..	,, 15	1,871	+ 596	..	..	..	..	..
Cen. London Rly.	Feb. 25	14,440	+ 206	8	57,631	+ 1,113	6	..
City & S. Lon. Rly.	,, 26	5,814	— 490	9	27,215	— 1,674	6½	..
Dublin-Lucan Rly.	,, 24	183	..	8	739	+ 10	7	..
G. N. and City Rly.	,, 25	3,253	+1,513	8	12,779	..	3½	..
L'pool Overh'd Rly.	,, 26	2,849	— 100	8	13,182	— 512	6·5	..
Mersey Railway ..	,, 25	3,183	+ 297	8	12,867	+ 961	4½	..

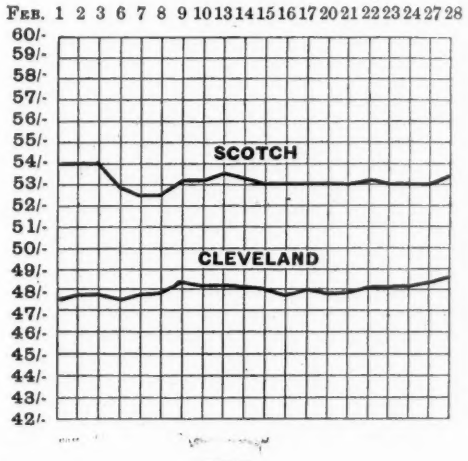
* Compared with the corresponding period of 1904. † One week only. ‡ Includes horse and other receipts.

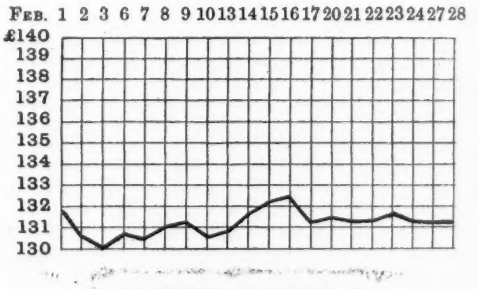
METAL MARKET.

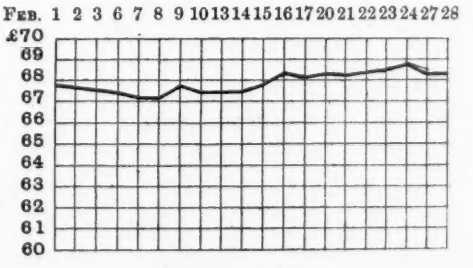
Fluctuations in February.











Imports of Foreign Electrical Apparatus.—The imports of foreign electrical goods and apparatus imported into this country during January last, according to the returns just issued, reached a total of £76,396, which contrasts with £86,236 in December last, and £74,674 in the first month of 1904.

INSTITUTION OF ELECTRICAL ENGINEERS.

SOME POINTS ON THE SELECTION OF ELECTRIC CABLES.

By Ll. B. Atkinson, M.I.E.E., and C. J. Beaver, A.M.I.E.E.

(*Abstract of Paper read at Manchester, January 31st, 1905.*)

(*Continued from page* 333.)

The permanency of such dielectrics as vulcanised bitumen is, of course, an important element; it is by many thought that they are absolutely permanent, but they are so only relatively, as they all contain elements affected by various external agencies. The action of the air gradually tends to oxidise and harden such compounds, particularly if they contain free oils or other oxidisable materials. Acids met with in mines, alkalies in works of various sorts, and some soils acting on other elements of the composition, have other effects.

To ascertain the effect of various reagents representing actions likely to occur in practice, the following were chosen:—

1. Copper sulphate 10 per cent., $CuSO_4 5H_2O$.
2. Ferric sulphate 10 per cent., $Fe_2(SO_4)_3$.
3. Ferrous sulphate 10 per cent., $FeSO_4 7H_2O$.
4. Sulphurous acid, saturated solution SO_2,
5. Hydrochloric acid 10 per cent., actual HCl.
6. Sulphuric acid, H_2SO_4, 10 per cent. by weight.

In these solutions the three typical samples, A, B, C, were exposed for five days.

Solutions 1, 2, 3, 4, practically had no effect on any sample; in 5, sample B became somewhat harder; in 6, all were slightly hardened, most markedly in the case of B. Care must, therefore, be used in adopting such cables, particularly class B, where acids are expected to be met with.

Oxidising agents were next tried as follows:—

Ozonised air, containing 0·4 per cent. O_3O by volume, 17 days' exposure.

A and C. Superficially hardened. B. Considerably hardened as a whole.

Hydrogen dioxide (10 per cent. H_2O_2). Five days' exposure.

A. Moderately hardened as a whole. B. Slightly more hardened than A. C. Only slightly hardened.

Chromic acid (10 per cent. CrO_3). Five days' exposure.

All the samples were attacked. Sample C best withstood the action of the chromic acid. Samples A and B were most severely attacked.

Chromic acid (0·5 per cent. CrO_3). 17 days' exposure.

A. Somewhat hardened as a whole. Surface not much more affected than body of material. B. Hardened through the mass. C. Superficially hardened.

Potassium permanganate (2 per cent. $K_2Mn_2O_8$) and sulphuric acid (1 per cent. H_2SO_4). Five days' exposure.

A and C. Little affected. B. Somewhat hardened.

Potassium permanganate (2 per cent. $K_2Mn_2O_8$) and caustic soda (1 per cent. NaOH). Five days' exposure.

All samples were severely attacked.

The action of alkalies was next tried.

Caustic soda 0·5 per cent. NaOH.

A and B. Somewhat attacked and softened, became hard and friable on washing and drying. C. Ditto, recovered fairly on washing and drying.

Sections were cut as thin as possible at ordinary temperatures, and then squeezed out between glass slips till they were thin enough for microscopic observation. The resultant films were examined, photographed, then exposed to the action of the reagent and again microscopically examined and photographed.

The following are Mr. Blount's notes of the microscopical observation of the effects of various reagents on the samples:—

Sulphuric acid (10 per cent. H_2SO_4). One day.

A. Considerably thinned. The attack not uniform. B. Attacked unevenly. C. Evenly thinned.

Hydrogen dioxide (10 per cent. H_2O_2). One day.

A and C. General thinning, slight differentiation. B. Some thinning, considerable selective attack.

Ferrous sulphate (5 per cent. $FeSO_4 7H_2O$). One day.

A and C. Slight uniform thinning. B. Section slightly thinned, some selective attack.

Chromic acid (1 per cent. CrO_3). One day.

A. Uniform change of structure. B. Considerably thinned. C. Very slightly thinned.

Caustic soda (10 per cent. NaOH). One day.

A. Specimen shrunken. B. Marked selective attack. C. Very slight thinning.

The results of these experiments show how certain agents not only have a surface action gradually thinning the insulating layer, but may, by selective action, be penetrating the mass. This latter effect would, of course, be enormously increased with cables carrying continuous currents and having earths on the circuit, on account of osmotic pressure forcing the chemical ions through the dielectric. Such action would be, in some degree, the equivalent of electrolytic action in lead-covered cables. This is worthy of note, as the freedom from such action is claimed as one of the strongest points in favour of the vulcanised bitumen type of cable.

The conclusion forced upon one is that to attain maximum efficiency in every respect, vulcanised bitumen compounds must be designed, made and applied with the greatest possible care. For instance, physical properties (such as resistance to decentralisation) must not be obtained by the sacrifice of chemical inertness.

Fibrous Dielectric, Waterproof Sheathed.—This class of cable is cheap, and if well constructed of good materials, is very efficient. Its high dielectric strength and low specific capacity render it

eminently suitable for extra high-pressure work, and it can be designed (by suitable adjustment of the ingredients of the impregnating compound) to give a high insulation resistance without (contrary to popular ideas) any deterioration of the dielectric, physically or mechanically. Such dielectrics have rather high temperature coefficients, and therefore engineers should be careful, in specifying insulation resistance, to state the corresponding temperature also.

We are able to show in fig. 4 a curve illustrating the variation of insulation with temperature. This shows roughly the order of such variation on a well-known type of paper cable.

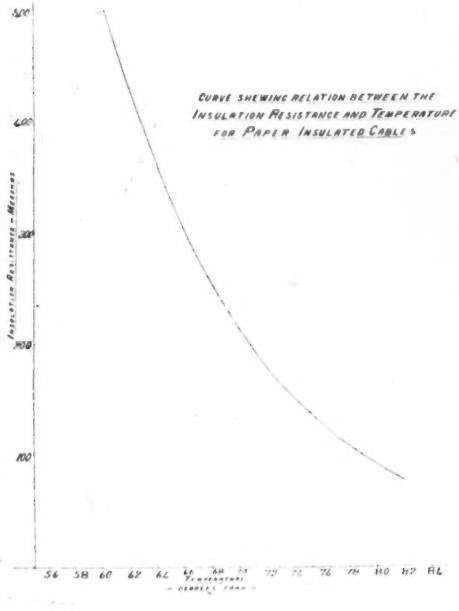

Curve shewing relation between the Insulation Resistance and Temperature for Paper Insulated Cables
500
400
300
200
100
56 58 60 62 64 66 68 70 72 74 76 78 80 82 84

Fig. 4.

It will be seen from the diagram that a paper cable which gives an insulation resistance of 500 megohms at 60° F. would only give 100 megohms at 79° F., this being approximately equivalent to a variation of 10 per cent. per degree F.

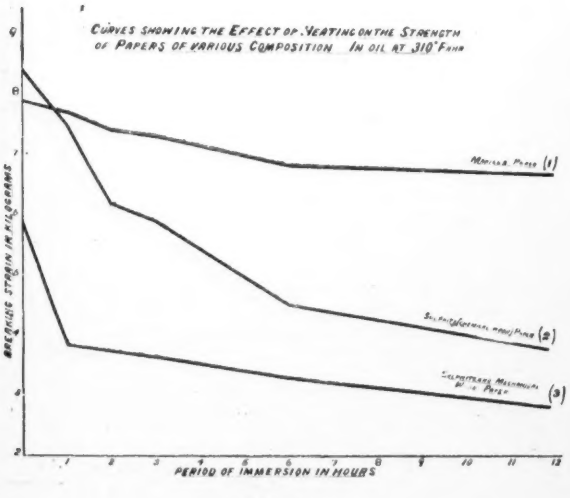

Curves shewing the Effect of Heating on the Strength of Papers of various Composition In oil at 310° Fahr.
Breaking strain in kilograms
Period of immersion in hours
(1)
(2)
(3)

Fig. 5.

The weak point of this class of cable is that, however well the fibrous material is impregnated, it is always liable to more or less readily take up moisture from the atmosphere, whereby its insulation resistance is reduced. Hence the necessity of covering with a waterproof sheath of metallic or non-metallic composition.

A few words as to the protection of the dielectric when the paper is exposed for jointing, or trimmed for connection, may be advisable here. On comparatively small jobs, suitable terminal ends are often omitted, pure rubber, or proofed tape, or both, being frequently substituted therefor. Even in making joints, materials which are not waterproof for electrical purposes, are often used. Care should be taken that only such materials as are non-fibrous, and can be made homogeneous, should be used.

The fibrous materials generally used are of two classes, viz., paper and fibre, the latter being usually jute or cotton, applied in the form of yarns, and afterwards impregnated. The former usually consists of Manilla paper, and comprises the great majority of cables which are now made with fibrous materials.

The oils used are generally resin oils, or mixtures of resin and resin oils, while Messrs. W. T. Glover & Co. use a compound made from oils called "Diatrine."

Engineers usually content themselves with specifying that pure Manilla paper must be used in their cables. "Manilla paper," to a paper maker or merchant, means a certain class of paper, in which one mill may make a dozen or more different grades, at prices varying from 6d. to 3d. per lb. Only two or three of the dearest of them are made from pure Manilla fibre.

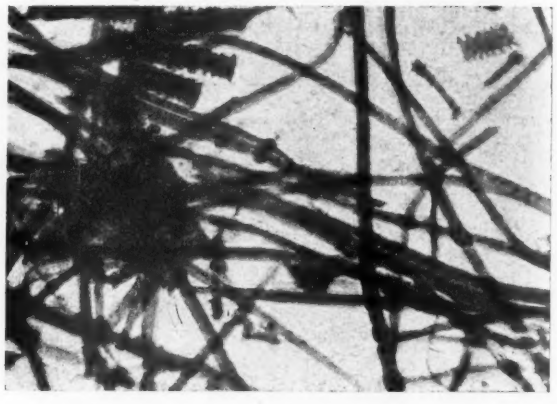


Fig. 6.—Esparto Grass.

A combination of factors has resulted in large quantities of paper cable being sold and used in the past, containing small proportions of Manilla (and in many cases none at all), and large proportions of straw, esparto, chemical wood, and even mechanical wood. Samples of Continental and American cables have been examined, in which chemical and mechanical wood papers were used entirely, and some German makers have gone so far as to maintain that chemical wood is preferable to Manilla.

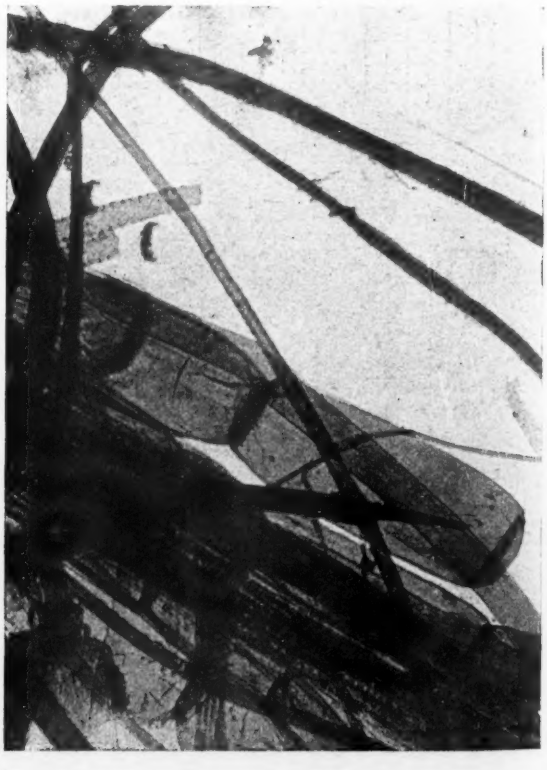


Fig. 7.—Straw.

The chief disadvantages of the introduction of straw, grass, or wood fibres in place of Manilla are as follows:—

(A) Lower dielectric strength and insulation resistance, and higher capacity.

(B) Deterioration in strength and elasticity of the paper when heated continuously or intermittently, and consequent brittleness.

(C) Danger of rotting in course of time, through the action of residual chemicals.

(A) It has been amply demonstrated by comparison of cable for 10,000-volt working pressure of a first-class British firm, made with pure Manilla paper, with foreign cable, made for the same working pressure, &c, the paper insulation of which contained chemical and mechanical wood only, that 70 per cent. greater thickness of the wood paper was required to obtain the same dielectric strength as the Manilla; and that even at the increased thickness the capacity of the foreign cable was not so low as that of the British cable; the calculated specific capacity being about double that of the British make.

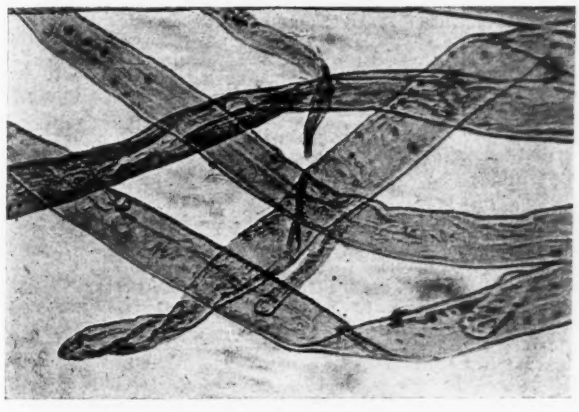


Fig. 8.—Chemical Wood.

(B) The extent and rapidity of the deterioration of woody papers under the influence of heat is shown in fig. 5.

It will be seen that the strengths of 1, 2 and 3 at the commencement of the tests were, 7·9, 8·4 and 5·9 kg. respectively. At the end of 12 hours the breaking strengths were 6·7 kg. for the Manilla paper, 3·75 kg. for the chemical wood paper, and only 2·8 kg. for the chemical and mechanical wood paper.

The curves shown represent the average results of about 100 separate tests on each class of paper, in some experiments carried out by one of us some years ago.

(C) The occlusion of the chemicals used in the preparation of straw, esparto, and wood fibres by the fibrous material is well known. The reason why this does not occur in carefully made Manilla is that the latter can be prepared with very little chemical treatment, and for cable purposes without bleaching, whereas in the former, very severe and drastic chemical treatment is necessary, and it is practically impossible to free the fibre from every trace of the reagents used.

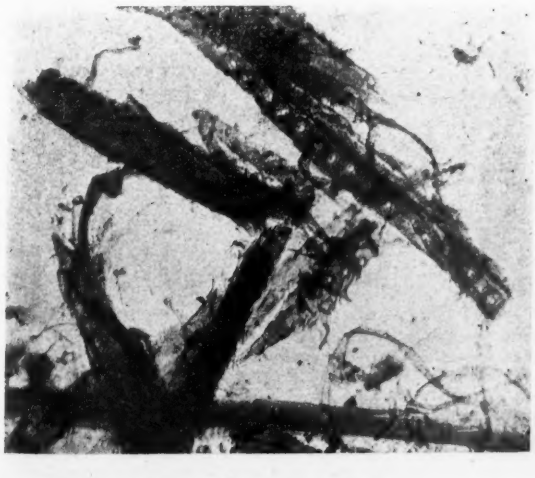


Fig. 9.—Mechanical Wood.

Appendix 2 includes a specification for paper, which should safeguard the interests of the buyer.

The matter of testing paper for admixture with the woody classes of fibre is quite simple. The preparation merely consists in extracting the insulating material with a solvent such as benzol, boiling the paper in a weak alkaline solution, washing with water and teasing out the fibres with needles, and mounting in the usual way in glycerine, or in a special reagent which by its differential action on various fibres colours them distinctively according to the class to which they belong, thus aiding the identification described below.

Fig. 6 shows esparto. The fibres are generally smooth, cylindrical, and uniform in diameter; the central canal is very small. On examining the paper containing the esparto under the microscope, it will be found to contain, in addition to the fibres, a certain number of serrated cuticular cells which are very characteristic.

Fig. 7 shows straw. The chief features of the fibre are generally similar to those of esparto. The pulp will also contain a number of serrated cuticular cells of more varied shapes and dimensions than those of esparto. A further distinctive feature of straw pulp is the presence in it of a number of lozenge-shaped cells derived from the pithy matter attached to the inside of the stem.

Fig. 8 shows chemical wood. The fibres are broad, flattened and smooth, with truncated ends, and are characterised by the presence of numerous pitted vessels in the fibres.

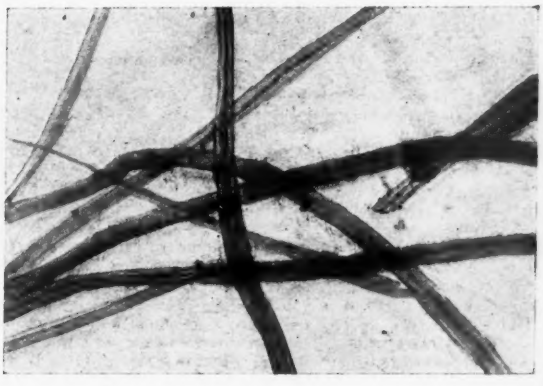


Fig. 10.—Manilla.

Fig. 9 shows mechanical wood. The fibres are similar to those of chemical wood, but seldom appear in their entirety, owing to the severity of the mechanical process which they have undergone. The pitted vessels are frequently even more marked than in the case of chemical wood pulp.

Fig. 10 shows Manilla. The fibres are smooth and regular, and have a wide central canal, though this is sometimes not very distinctly marked. They are entirely free from any of the characteristics noted in the case of the above-mentioned fibres, such as pitted vessels or serrated cuticular cells.

It will thus be seen that the characteristic forms of the fibres to be specially avoided are very definite and easy to identify.

The impregnating compounds used by different firms vary considerably. From an electrical point of view they should be designed to have the highest possible dielectric strength and specific insulation; the specific inductive capacity should approach as nearly as possible to that of the fibrous material. As regards consistency, it should be plastic but not fluid.

(To be concluded.)

THE VALUE OF OVERHEAD MAINS FOR ELECTRIC DISTRIBUTION IN THE UNITED KINGDOM.

By G. L. Addenbrooke.

The discussion on the above paper was opened on the 23rd ult. by Mr. J. Gavey, who expressed the opinion that the present was an appropriate time for bringing forward such a subject. He had several questions to ask the author in regard to the varying cost of overhead mains for different voltages; were the figures inclusive of wayleaves or diversions, and were more than three wires included on a pole line? He referred to a transmission line at Milan where 18 wires were used, in six groups of three each; normally, all the above wires were in use, but half were sufficient to carry the load, so that the other half could at any time be repaired. He thought that the cost of doubling an underground transmission line would not be so high as the author suggested, at any rate, if ducts were used and spares provided. In England the telegraph and telephone lines occupied the sides of the highways, and three-phase transmission lines, if in proximity, would cause inductive disturbances. The Valtellina Railway authorities had incurred considerable expense in connection with the above, but their transmission lines were not spaced well; the Milan transmission wires were symmetrically placed, and the groups of wires were rotated, as a whole, at intervals along the line, thus neutralising inductive effects. He went on to refer to the obstruction usually offered to the erection of overhead lines; local authorities and private individuals being too frequently unreasonable in their attitude.

Mr. R. S. Porthеim, referring to the North Wales Power Co.'s scheme, said that its existence absolutely depended on the use of overhead transmission. It had powers to transmit some 10,000 H.P. at a pressure of 10,000 volts, and in some places the routes lay along public roads. About 60 miles of overhead wires were being put up, at a total cost of £40,000, as compared with a probable cost of £150,000 if placed underground. On the railway connected with the scheme, the overhead transmission line ran parallel with the railway and (in accordance with Board of Trade stipulations) 2 pole lengths from the trolley line. At Valtellina, the 20,000-volt trans-

mission lines were on the same poles as the trolley wires; they had had no accidents, while the N.E. Railway, on its third-rail system, had had many. The North Wales Co. had experienced no trouble with either the Post Office or the Board of Trade.

Mr. C. P. Sparks expressed the opinion that the author was hardly fair in blaming legislation for the poor progress made in overhead transmission work in this country. Like other nations, we started to distribute by means of overhead wires in the early days of electric lighting. In 1888, an Act of Parliament required that overhead distribution should be discontinued, and as this overhead work was in the towns, the prohibition seemed justifiable. The real veto under the 1888 Act was that of the local authority. Under the Power Companies' Bills, permission could be obtained to put up overhead wires if desired, but apparently the companies had not moved in the matter. In his opinion, wayleaves were the greatest difficulty in connection with overhead work, and the solution was to utilise the main roads, avoiding P.O. routes. He had recently erected some miles of overhead transmission, and experienced little difficulty in the matter of wayleaves.

Mr. H. M. Kensit, discussing the question of wayleaves, said that one obstructionist might result in altering an entire route. Poles were a nuisance in the centre of a field, especially if the latter were a ploughed one; and the rent asked might be as high as £1 per pole, with an average of about 8s. per pole.

Mr. A. Bloemendal referred to the many difficulties encountered in this country in connection with overhead transmission work. He instanced the case of a colliery installation which was abandoned owing to the promoters not being allowed to utilise high pressure and overhead transmission. In Northern Bohemia, both the above were in general use by colliery owners, road crossings being protected by netting, and telephone and telegraph circuits by fuses. In his experience he had only once come across a breakage of an overhead transmission wire, and no damage resulted. In a Continental transmission with which he was acquainted, the line was 34 miles in length, and the working pressure 21,000 volts, but only three transmission wires were used. There had only been one accident on this line, and that was due to a sparrow flying into a lightning protector and causing a short circuit. In practice he found the Wurtz type of lightning arrester very successful, and trials of a horn-type arrester with magnetic cut-out were also favourable. The author's reference to the protection afforded to overhead lines by the law, was very interesting; in a case on the Continent, he had found it more efficacious to refer defaulters (who were mostly juvenile) to the parson and schoolmaster, rather than to the policeman.

Mr. F. Pooley, after reading the paper, formed the conclusion that there was a bad time in store for cable makers; there would, however, still be distributing networks in the more populous places and in small towns, which, but for overhead transmission, would not be in a position to obtain a supply at all. He considered that faults in overhead lines would be much more easily repaired, even if there were more of them. The unsightly appearance of a pole line was usually a very serious objection, as the Post Office authorities had found out recently, when trying to put up a telegraph line through Epping Forest. He suggested that pitch pine poles would last as long as creosoted ones, and look far better; the creosoted poles could not be painted, as suggested by the author.

After a few remarks from Mr. Leon Gaster,

The author replied to the discussion. The variation in cost with different pressures, referred to by Mr. Gavey, was due to insulators, fittings, &c., and higher poles. The tables given in the paper were for three wires on one pole. He found that a large proportion of such lines only had three wires and depended on them, but they could add extra wires very cheaply if wanted. In connection with a South Staffordshire coal mine, in which he was interested, it was desired to take a supply of energy from a power company, whose mains lay some half a mile away. The company asked some £400 and an interest guarantee for making the connection (which was for 100 kw. in the first instance), and this cost would probably be doubled when further power was required. The author compared this with the cost of a pole line, greatly to the advantage of the latter. In America it was the habitual practice to run telephone signalling wires on the same poles as the transmission lines, and no trouble was recorded from induction or other electrical causes. In connection with Mr. Portheim's remarks, he was surprised to hear that H.T. transmission lines were allowed on the main roads in Wales. Despite Mr. Sparks's views as to there being a mistaken sentiment in the paper, he affirmed that there was strong resistance on the part of the B. of T. to overhead transmission, on principle, and when it came to putting things into practical form. In the matter of wayleaves, it should be noted that spans of 150 or more yards were now easily obtained with stranded cables, and this, of course, decreased the number of poles very much in comparison with the earlier lines. Aluminium he did not think suitable for long spans on account of its poor tensile strength.

After a few remarks from the author on the laws of expropriation, Mr. Patchell moved a vote of thanks for the paper, suggesting that, after reading it, the local authorities might come round to the conclusion that the public roads were made for overhead lines.

Customs Duty in France.—It has recently been decided to levy a duty on electric measuring instruments introduced into France. The duty is established in the following manner:—Above 2,000 kg., 35 fr. per 100 kg.; from 1,001 to 2,000 kg., 40 fr. per 100 kg.; from 501 to 1,000 kg., 45 fr. per 100 kg.; from 1 to 200 kg., 60 fr. per 100 kg.; less than 1 kg., 75 fr. per 100 kg.

THE PROPOSED ELECTRICAL EXHIBITION.

At the Hotel Cecil, on Monday afternoon, a meeting of representatives of electricity supply companies and municipal electrical undertakings was held. Mr. W. H. Patchell (Charing Cross and Strand Electricity Supply Corporation) was elected to the chair. In the course of his opening remarks, Mr. Patchell said that he had had a good deal to do with the exhibition movement. It had been felt that the Institution of Electrical Engineers had not done what it ought in the matter. He was not speaking on behalf of the Council, but the Council was asked last autumn from four different quarters whether it would support an electrical exhibition. Its reply was to the effect that it did not see its way to recommend the Institution to extend its patronage to an exhibition promoted by a single individual, or group of individuals, working with a view to private gain to themselves. Later, after meetings at his (Mr. Patchell's) office, it was thought that an electrical exhibition depended mainly on the exhibitors. They, as supply engineers, were very keen to get an exhibition. The pulse of the supply companies was felt, but they did not quite know how the municipalities stood in regard to the matter, though it was considered that they could buy a few thousand tickets, and send their ratepayers up to the show. There was no hesitation as to an exhibition being necessary—a really big or epoch-marking one. The object of this meeting was to hear from the Electrical Manufacturers' Association how the matter stood with them, and just what sort of support they wanted the supply engineers to give.

Mr. Davenport, the secretary of the National Electrical Manufacturers' Association, then explained to the meeting that he knew nothing about electricity—he only knew business. There would be no promotion money, and if there were profit a part of it would be returned to the exhibitors and the remainder handed over to a benevolent fund. They thought that they should be helped by the supply authorities in the form of donations—or in some other form by those who were afraid of surcharges by the L.G.B. A number of municipal and other engineers had written to say that they favoured the idea of the exhibition because they believed it would benefit them, and one Council had made up its mind to drop a small proposed exhibition in order to take part in the large one, as it would have a lasting benefit for the electrical industry. None of the correspondence threw cold water on the project. After further comments from Mr. Davenport,

Mr. Patchell asked whether the heavy manufacturers showed signs of exhibiting, or only small ones? They, as supply engineers, must, presumably, run the risk of private installation plant being shown. Was it to be a consumers' show or otherwise?

Mr. Davenport said that the big firms were coming in. Seventy, including some large firms, had already done so. The purpose of the meeting was to get financial help, for the managers must not feel that they were spending money out of a loss. They must have plenty of money; £3,000 would be sufficient, either in ticket money or some other form. In regard to the proposal that one member of the executive should be a representative of the electrical Press, at the request of the Press that nomination had been withdrawn, and it was now suggested that it should be given to the Municipal Electrical Association.

Mr. Fuller (Fulham) said that there was a difficulty of getting any municipal money spent for this purpose because of the question of surcharges; but it might be possible to spend the money on tickets, and charging it up as advertising expenditure. A later speaker suggested charging the tickets to stationery, a remark which called forth the rejoinder that no doubt the supply representatives would be able to find some way or other out of the difficulty.

Mr. Cottam (Hampstead) thought it would be difficult to get blood out of a stone when they had the L.G.B. behind them. His own Committee had discussed the question of a local exhibition, but they could not get a suitable hall, and they said that they had not power to vote any money whatever. Whether they had power to vote money for tickets he did not know.

Mr. Baynes (St. Pancras) said that his Council would support the idea so far as they could legally do so. They had decided to hold an exhibition of their own, but he did not think that they would now carry that into effect.

The Dover engineer said there had been no opportunity of submitting the matter to their Council, so that he could not pledge their support in any way. An exhibition was very desirable, but he could not get away from the fact that they were away from London a little distance, and he could not see how they were going to get any great benefit from it as compared to a local exhibition. A local exhibition might be visited by anything above 20 per cent. of their ratepayers, but an exhibition in London would be anything below 1 per cent. If Dover people came up to London they might see some nice effects and exhibits, but they might naturally consider that these things were all very well for London, but "we cannot do them in Dover." Their own local exhibition from their own local supply would show them what they were capable of doing in their own houses.

The meeting then proceeded to the election of the supply representatives on to the committee, and the following was the result:—

Mr. Cunliffe Owen, of the Metropolitan Electric Supply Co.
Mr. W. H. Patchell, of the Charing Cross and Strand Co.
Mr. S. Dobson, of the St. James' and Pall Mall Co.
Mr. S. W. Baynes, of St. Pancras.

The municipal works will also be represented, as already stated, by the M.E.A. representative.

It was announced that the exhibition will take place from September 24th to about the same date in October.

The Secretary of the Manufacturers' Association will shortly be communicating with supply station authorities, stating the position of the matter, and asking what support they are prepared to give.

THE CONVERSION OF A TELEPHONE EXCHANGE FROM THE MAGNETO TO THE CENTRAL BATTERY SYSTEM.

By B. S. COHEN.

(*Continued from page* 291.)

Whilst the exchange is under construction, the outside engineering and the instrument-fitting departments will be at work.

The work to be done by the former will vary according to the existing conditions. If the subscribers' lines are already underground, it will merely be necessary to divert the ducts and cables into the new premises, making the diversions in such a manner that the existing cables leading into the old exchange are teed or looped into the new cables, and can be cut away from the latter when the change-over is effected.

If the system is an overhead one, and owing to wayleave difficulties it is quite impossible to put the wires underground, then the only alternative is to put as many of the open wires as possible into aerial dry-core cable.

For underground work, the modern tendency is to use cables with a large number of pairs, 306-pair cables, and considerably over, being quite commonly used. For conduits, glazed earthenware pipes, laid in cement or cement blocks, are probably the most satisfactory.

The distribution from the termination of the underground cables to the subscribers' offices, is generally effected by means of open wires, and with a properly-designed system the aim should be to keep the length of the open distributing wires to a minimum consistent with reasonable expenditure. With an underground system already existing, the new cables will be either looped or teed in, the method adopted depending on the distance between the old and new exchanges, and the position of the new exchange with respect to the heaviest cable routes.

Figs. 4 and 5 show arrangements of the cables generally adopted when the new exchange is quite close (within a couple of hundred yards of the existing one). In the first arrangement tee joints are made, and in the second the cables are looped in. It will be seen from the drawing that the operations at the change-over are simple, it merely being necessary to disconnect the old exchange by inserting wooden plugs into the test jacks. The old leads can be cut away after the opening of the new exchange. When fig. 5 is adopted, the old exchange can be immediately disconnected by cutting away the temporary cross-connections at the new exchange, and the old cables can be recovered without interfering with the live cables. With the teed-in system, however, the live teed joints have to be stubbed. On the other hand, the looped-in system is not so economical in cable. Further details of the change-over will be described later on. When the new exchange is some distance from the old one, and is on the heaviest side of the routes, as it should be if its position is an improvement on that of the old exchange, a modification of the looping-in method must be employed.

Fig. 6 illustrates this method. The cables passing the new exchange are cut into and cables leading both in and out are brought on to the main frame. The subscribers to the right of the new exchange have thus had their lines shortened and the lengths of cable between the old and new premises will be used temporarily for maintaining the circuits through to the old exchange, and when the change-over is made are available for bringing in the circuits to the left of the new exchange. To illustrate this, two lines are shown on the drawing, viz.: Nos. 840 and 300, of which 840 is assumed to be a subscriber to the right of the new exchange, and 300 is one to the left of the old exchange. The cable carrying the line in from 840 is terminated on a pair of horizontal terminals on the main frame in the new exchange and cross-connected to the pair of arresters in connection with No. 840 line inside the new exchange, and it is assumed that the line out from 840 to the old exchange will be

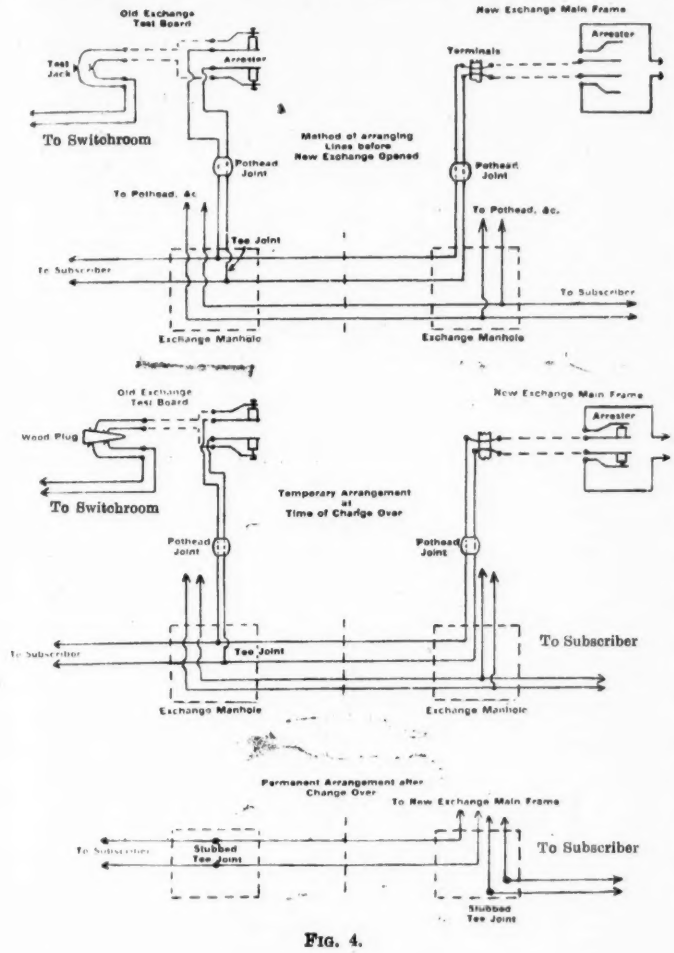


Fig. 4.

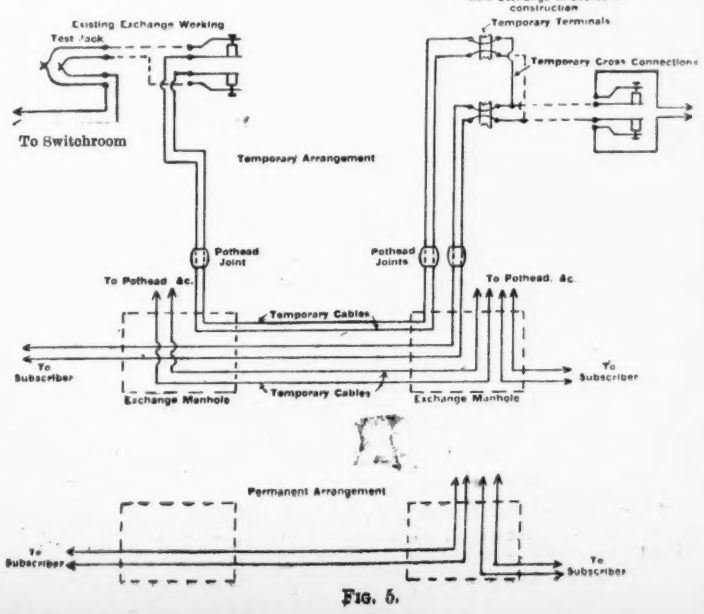


Fig. 5.

ultimately used for bringing in No. 300 to the new exchange. This line out is terminated on another pair of terminals, and cross-connected to 300 line inside the new exchange. In order to keep No. 840 working until the change-over takes place, temporary cross-connections marked A and B are run, connecting the line-in to the line-out. Now turning to the old exchange, the working test jacks and arrester in connection with lines 840 and 300 are shown, and an additional test jack, C, which is a temporary arrangement, is also shown, wired to both 840 and 300. A wooden insulating plug is inserted in this test jack, and it will be seen that, when the plug is withdrawn, 300 and 840 will be connected together as far as the old exchange is concerned.

When the change-over takes place, the insulating plug is withdrawn at the old exchange, and the temporary wires A and B, which are of a different colour to the permanent wires in order that they may be readily identified, are cut away in the new exchange; 300 and 840 will

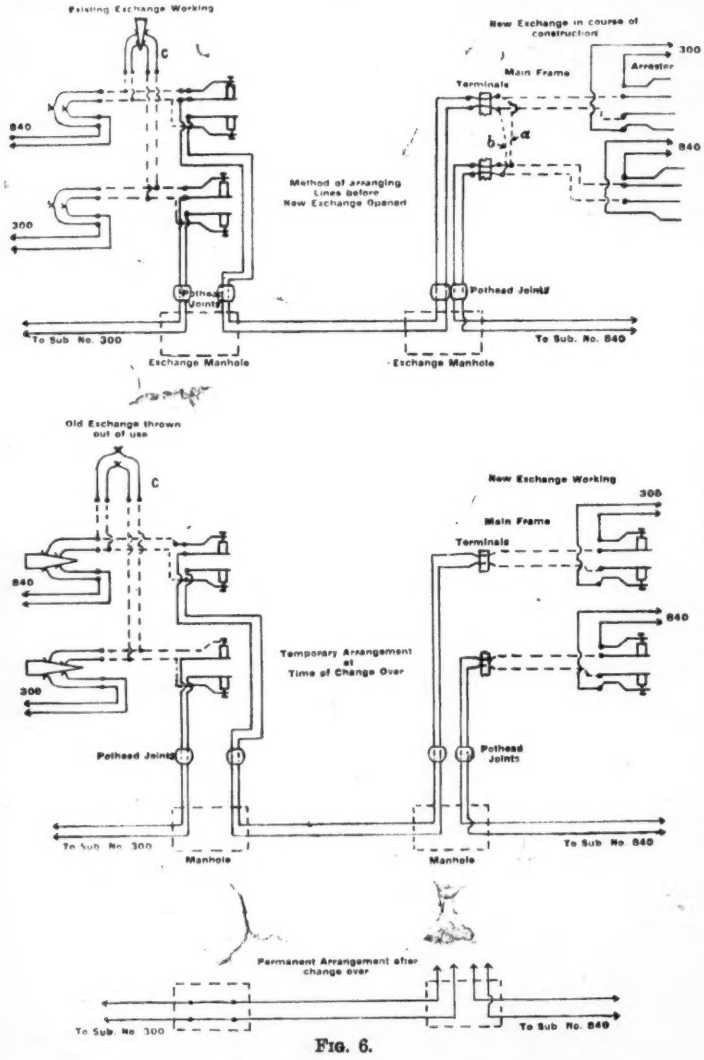


Fig. 6.

then be working through to the new exchange. The permanent connections are also shown in fig. 6. It will be realised that great care must be taken in planning this method out. The leading-in cables from the pothead joints to the horizontal side of the main frame are generally made up of 22 S.W.G. wire, insulated with a combination of silk and cotton, and protected by a lead covering. They are made with a similar number of pairs to the cables to which they are joined, and are very compact; thus the 306-pair size is only 2 in. overall diameter.

(To be concluded.)

Sydney Tramways.—About the middle of January the last cable-car was run here, and the electric cars were introduced on the King Street section.

THE FUTURE OF RAILWAYS.

By PHILIP DAWSON.

(Continued from page 288.)

Advantages of Electric Traction.—In addition to the fact that the high acceleration demanded for the proper operation of suburban traffic can only be obtained from the use of electric power, there are several further advantages possessed by the modern method of traction which render it greatly superior to steam haulage. Steam trains have to carry their own power, *i.e.*, a locomotive must not only be able to haul a certain weight of train, but it must carry coal and machinery to consume the same and convert its heat energy into tractive energy *en route*, and a steam locomotive is a most uneconomical instrument for transforming heat into work for traction purposes. This adds to the weight of the train, and greatly increases the weight to be hauled per passenger. On an average it will probably be found in the case of suburban trains that the locomotive weighs over one-third of the total useful weight of passenger coaches hauled.

In the electric system the heavy locomotive is replaced by a comparatively light motor-car, and energy is generated under the most economical conditions at a central power station from which it can be transmitted many miles with but slight loss.

The wear and tear of the permanent way, particularly at junctions, is considerably less with electric than with steam traction, as the former obviates the rolling and pitching which occur with steam locomotives due to the movement of their reciprocating parts.

Electric trains with two or more motor-cars on the multiple unit system have the great advantage of distributing the weight of the train more evenly over the track, and the larger number of driving axles lessens the load on each driving wheel. A steam locomotive has to be heavy enough to give sufficient weight on the driving wheels to haul the heaviest trains up the steepest gradients at the highest required speeds. This concentration of the weight is very detrimental to the track, and the bad effects are accentuated by the pounding action caused by the reciprocating motion of the engine.

For the same weight on the driving wheels an electric motor can exert a much greater tractive effort than a steam engine. This is because the electric motor exerts a constant torque upon the driving wheels, whilst the steam engine does not. In the case of steam locomotives the ratio of the maximum tractive effort to the weight on the driving wheels is not much above 16 per cent., whereas experience has shown that with electric traction the tractive effort may be 25 per cent. to 30 per cent. of the maximum load.

The cost of operating electric trains, as compared to steam trains, can be reduced by taking advantage of the fact that only one man is required, that is to say, only a driver instead of both a driver and a fireman. The Board of Trade should take no exception to this, as should the driver be incapacitated in any way, the method of control employed automatically brings the train to a standstill.

Electric traction is much more flexible than steam, and trains can either be split up into units of one or two cars or joined up into trains, the length of which is only limited by the length of platform available.

There are other advantages, but the crowning one is certainly the much higher average speed due to rapid acceleration and the economy of power and labour, as well as the reduced cost of production which is everywhere effected.

An incidental advantage in favour of the electric motor, as compared to the steam engine, is that the former, besides

having far less internal friction, can stand an amount of continuous service and hard usage which would be impossible with the latter.

A most important benefit resulting from the use of electric traction is the diminution of the present difficulties due to the lack of accommodation in termini. Mr. Aspinall, the general manager of the Lancashire and Yorkshire Railway, has stated that the recent electrification of the line from Liverpool to Southport will not only double the carrying capacity of the line, but will also practically double the terminal accommodation. How this is brought about is easily seen when we consider the time wasted at present in getting a steam train out of a station after it has once entered. First the line has to be cleared to allow another locomotive to back on to the train in readiness to take it out, which it does. Then before another train can be brought in, the line has to be cleared again, so that the original locomotive which brought in the first train can run out. These various manœuvres occupy a considerable amount of time, besides necessitating a considerable amount of siding accommodation, not to mention possible blocking of other lines by the steam locomotives constantly running out and backing on to the trains. The operation of running a train into a station and getting it out again takes, in most cases, from 5 to 7 minutes.

Contrast this with what can be done in the case of a double-ended electric train. The train runs into the station, the driver walks from one end of the train to the other, and it is ready to start out again in from 1½ to 2 minutes after its arrival. It should be possible to save at least 4 minutes on each train entering and leaving a terminus, and naturally this would enormously increase the terminal facilities and prevent much of the congestion which is such a source of trouble and difficulty under present conditions.

The above are a few of the advantages to be obtained from the adoption of electric traction upon suburban lines. The application of electricity to main line traffic is quite a different matter to merely electrifying suburban lines. However, it is obvious that, other things being equal, the most advantageous system of electric traction for suburban lines is the one which presents the greatest possibilities of ultimate extension to main line working.

Results of Railway Electrification.—A large amount of valuable data which are quite applicable to the conditions which would have to be met on our railways, have been supplied by interurban and elevated electric railways in America, which operate trains of two and more carriages. From these can be obtained much useful information as to speed, number of passengers to be conveyed, weights to be handled, type of motor required, cost of locomotive power per ton, cost of generating and distributing power and the load factors obtainable.

Although electric traction both on railways and tramways was first applied in this country, the strides made in America have been so rapid that, as in tramways 10 years ago, America was far ahead of Great Britain, so now, in the installation of high-speed elevated and inter-urban railways, America is the country to which we have to refer in order to ascertain what may be expected from the electrification of suburban railways in the United Kingdom, both as regards increase in traffic and operating expenses, cost of maintenance and probable net receipts.

It was urged by many people that American experience in electric tramways would be of no use in this country, on account of the different conditions under which they would operate, but results have shown this contention to be incorrect. Therefore, there should be still less hesitation in drawing on the experience of America in the matter of electric railways, since in this case the conditions in the two countries are much more nearly parallel than was the case with the tramways.

It is impossible to emphasise too strongly the fact that good and cheap travelling facilities create traffic. It is quite true that competing tramway lines, when electrified, have decreased the number of passengers carried by the railways, but it erroneous to suppose that the bulk of the traffic of the tramways has been filched from the railways in this way. By far the greater portion has been created, and it an entirely new traffic which has hitherto been lying dormant. This was amply demonstrated by the electrification of the Manhattan Elevated Railway, which resulted in an increase of 20 per cent. in the passengers carried, and 28 per cent. in the net revenue, over what has been done under steam conditions. The result is a particularly convincing proof that traffic can be created, since, as a steam road, the line was operated under most favourable conditions, and it did not seem possible for it to carry any more passengers than it was doing then.

English railway companies have progressed very considerably of late. The track construction is probably better than any to be found in the world, and the locomotives, signalling apparatus and rolling-stock are, as far as steam traction is concerned, beyond criticism. At the same time, as already pointed out, the competition of electric tramways, and the demands of the public for increased facilities of locomotion, require a development on entirely new lines. As trustee to many millions of the public money, it is evident that no railway company can take any action involving considerable expenditure and the adoption of a novel system, except with the greatest care and the most careful investigation. Necessarily, the railway companies would prefer to be perfectly certain of the results before taking any important steps, and to know what has been achieved financially by electrification of other lines. The figures of cost of operating and receipts on the tube lines and on the Liverpool Overhead are very instructive, but at the same time, owing to the different conditions under which they are constructed and operated, their results cannot be absolutely applied to this case. It will be some years yet before reliable information is available of the results obtained on the Lancashire and Yorkshire and North-Eastern Railways; and therefore the experience of the Mersey Railway, corroborating as it does in principle the statements I have set forward, is most useful. The conversion of the Mersey line was taken in hand, and was in progress during 1902, and was completed in May of 1903, and therefore it could hardly be said to have got into full working order during the latter half of that year for which accounts were available. Under these circumstances, it is not necessary to go into these accounts in detail, but it is interesting to note that the three-minute service which they installed caused their train mileage to be increased from some 155,000 miles to over 401,000 miles in six months, and that this result was justified is shown by the fact that the number of passengers increased from 2,844,708 to 4,153,777, and the results show that the traffic was almost entirely made up of first and third-class passengers, the second-class having to be greatly diminished, as might have been anticipated.

Similar results have been obtained on some of the branches of the New York, New Haven, and Hartford Railways, U.S.A., which have been electrified. The figures given by Col. Yorke in his report on his visit to America, show that the traffic owing to electrification increased by amounts varying from 30 per cent. to 189 per cent. on the different branches.

The results consequent on the electrification of the Milan Varese line of the Mediterranean Railway Co. are no less surprising. For six months ended June, 1903, the total number of passengers carried was 2,977,812. During the whole year 1900, when the line was entirely operated by steam, the total number of passengers carried was 2,768,541. Hence, even assuming that the results of the second six months of 1903 were only equal to those of the first, instead of superior, as would most probably be the case, we have, for the whole year, a total number of passengers carried of 5,955,624; an increase of 3,187,083 passengers, or 115 per cent. increase on the number carried during the year 1900.

The evidence given before the Royal Commission conclusively demonstrates that the solution of the London traffic problem is to be found in the development of the suburban service of the existing railways in conjunction with each other, and with existing and projected tube lines, surface, or shallow conduit lines. Some idea of the traffic to be handled as regards this portion of London may be obtained from the evidence given before the Royal Commission, that there are 600,000 passengers brought in and taken out per day, and that this figure only include the "regular" fares, that is to say, those who come in the morning and spend the day in London and go back at night. If we take into consideration the number of people who do not spend the day in London,

but who only go in for a time either for pleasure or business, it means that as regards the central area of London, over three million passengers a day have to be dealt with, and it is to be noted that these figures do not include passengers coming from the West End, of which there is a large number.

In estimating the probable traffic resulting from electrification, it must be borne in mind that the present number of passengers is little or no criterion as to what will be done with an improved service, which will undoubtedly create a very large volume of entirely new traffic. The question of the probable shopping and pleasure traffic which would grow up has been treated elsewhere, but in connection with what has been said concerning suburban inhabitants coming to town for theatres, it is interesting to note that it was stated in evidence before the Royal Commission that in the central area of London there are over 125 theatres, having a seating capacity of 120,000 people. In addition to this, new places are constantly being built without any apparent detriment to the success of the existing ones.

There is a source of traffic which should be by no means overlooked, viz., pleasure traffic other that the theatre traffic which has been mentioned earlier. In America a very large volume of traffic has been created by properly exploiting pleasure grounds, and there is no reason why the same should not be done in England. Thus the Crystal Palace, which at present does not receive the amount of attention it deserves, might, with proper transit facilities, become a very considerable source of revenue.

It is not too much to say that the Crystal Palace, with its imposing building and fine and extensive grounds, might be made to become one of the most popular pleasure resorts of London, and attract an annual attendance hitherto undreamed of.

Electrification would result in people living much further from London than they dare do now, and there would be nothing to fear from tramway competition in this service; in fact, for any distance of, say, five miles. The maximum schedule speed of electric tramways does not at present exceed 10 miles an hour, and thus the journey would take 30 minutes. The electric train, on the other hand, could easily average 25 miles an hour, if not more, and would perform the journey in 12 minutes, thus effecting a saving of 18 minutes per journey, or 36 minutes per day.

It is important to note that the City of London is far better served in respect to the location of termini than any of the large cities on the Continent and in America. In many of the latter the stations are some distance from the centre of business, and hence the railways are considerably handicapped in the matter of bringing passengers from the suburbs and depositing them at the points they wish to reach, and consequently the bulk of traffic is handled by tramways. But as pointed out above, this is not the case in London, where the suburban lines, if electrified, would be in an excellent position to meet all the requirements of the situation.

Comparison of Cost of Electric and Steam Working.—The driving of a steam locomotive requires a high degree of technical skill, hence the cost of wages is considerable, and it is not advisable to economise in this item, because the efficiency of the locomotive depends so largely on the manner in which it is handled. The cost can be largely reduced by electric traction, since the work is simpler and easier, and can be done by one man in place of two.

The steam locomotive is not only expensive to operate, but also it costs a great deal in repairs, which are naturally much greater than they would be in the case of the plant installed in a generating station. The use of forced draught, the constant changes in the temperature of the fire-box and tubes owing to the momentary inrushes of cold air, and the exposure to dust, dirt and wet, are all detrimental to economy, and there is a constant liability of dust being drawn into the valve chests.

Steam locomotives are not efficient except when operating at full power and at high speeds, and hence, the majority of the time they are working at a very low efficiency, especially when operating a suburban service. This is not the case with electric motors.

As already mentioned, the dead or useless weight per passenger hauled is considerably reduced by electric traction, with a consequent saving in cost of power and also the cost of working it practically proportional to the ton-mileage, instead of being nearly independent of it, as is the case with steam locomotives. There is also an economy of power whilst coasting, braking and stopping, which is quite unattainable with steam power, and on a suburban system this means a considerable saving, since the stops are so frequent. The amount of fuel consumed by a steam engine whilst stopping at stations is not much less than the consumption when running.

There is great difficulty in comparing the cost of working of steam and electricity trains, because with the former the cost varies almost directly as the train mileage, and not as the ton mileage, whereas the latter depends almost entirely on the ton-mileage. This is where the advantage of electric traction comes in, because it permits short, small-capacity trains to be run at a low cost during the hours of light traffic, the size of the trains being suited to the demand. Also the electric service enables a far higher schedule speed to be maintained. On the Metropolitan District Railway as at present operated by steam, the maximum schedule speed possible is 13 miles an hour excluding stops, with stations, on the average, half a mile apart. After electrification this speed will be able to be raised to 16 miles an hour including stops.

When we investigate what the probable cost of operating electric trains is going to be, we can base our figures entirely on ton-mileage, since, as stated previously, the locomotive cost of an electric train is practically proportional to the ton-mileage, which is not the case with steam trains.

It must be noted that experience has shown that with electric haulage repairs to coaches are smaller than with steam haulage, owing to the lesser wrenching at starting, and consequent less severe strain on the cars, due to the constant torque of electric motors and the multiple unit system, which does away with the necessity of exerting all the draw-bar pull from one end of the train.

The following figures of the Mersey Railway may be of interest:—

Working Costs of Mersey Railway.

	Steam service per train-mile.	Electric service per train-mile.
Maintenance of permanent way ...	3·9d.	1·6d.
Locomotive and generating power ...	11·3d.	5·2d.
Traffic expenses...	13·5d.	7·3d.
Cost of ventilation	3·4d.	0·2d.
Cost of pumping	4·85d.	1·5d.
Total working expenses	41·2d.	18 2d.

(To be continued.)

THE TELEPHONE AGREEMENT.

The following are abstracts of the schedules attached to the agreement set forth in our last week's issue, page 298:—

The First Schedule

Defines the areas where the licence of 1884 has been extended beyond December 31st, 1911, viz.:—

Glasgow, extended to December 31st, 1913, by agreement of July 8th, 1901.

Portsmouth, extended to June 30th, 1926, by agreement of August 11th, 1902.

Tunbridge Wells, extended to April 30th, 1925 (subject to determination by Postmaster-General on December 31st, 1911, under agreement of October 10th, 1903), by agreement of August 11th, 1902.

Swansea, extended to December 31st, 1920, by agreement of September 27th, 1902.

Brighton, extended to April 30th, 1926, by agreement of May 16th, 1904.

The Second Schedule.—Competitive Exchange Areas.

Abergavenny.	Merthyr Tydvil.
Bridgend.	Newcastle-upon-Tyne (with Gateshead).
Brighton.	Newport (Monmouthshire).
Briton Ferry.	Pontypool.
Cardiff.	Pontypridd.
Glasgow.	Portsmouth.
Hull.	Swansea.
London.	

The Third Schedule.—Specification and Rules as to Plant.

1. In this Schedule the term "Exchange Subscriber's Circuit" or "Circuit of an Exchange Subscriber" means the wires and apparatus connecting a call office or a subscriber's office (whether on an exclusive line or a party line) with an exchange, and the term "junction circuit" means the wires and apparatus which connect

any two exchanges in the same exchange area or an exchange and a prescribed post office in the same exchange area.

The term "test cable" means a telephone dry-core cable, the wires of which have a loop resistance of 88 ohms per mile and an average mutual electrostatic capacity of 0·054 microfarad per mile between wire and wire of each pair and an average insulation of not less than 200 megohms per mile between wire and wire of each pair, all measurements being made at 60° F.

The term "test instruments" means common battery instruments fed by a battery, of 22 volts through a circuit which, except so far as it consists of exchange apparatus and subscribers' instruments, shall have a resistance of 300 ohms (all being in accordance with the specification and diagram identified in duplicate before the execution of this agreement by the signatures of the engineer-in-chief to the Post Office and the engineer-in-chief to the company).

2. (1) All circuits, whether exchange subscribers' circuits or junction circuits, shall be metallic.

(2) All circuits, when used for speaking on local exchange lines or through to a trunk circuit which itself is free from disturbance, shall be free from inductive or other disturbances.

(3) All circuits shall be so arranged, that each exchange subscriber shall be unable to overhear what passes on any other than his own circuit or those to which it is joined through.

3. The use of iron conductors shall not be permitted in any portion of a circuit.

4.—(1) All buried cables shall be efficiently protected by iron pipes, or by ducts of glazed earthenware laid in concrete, or by cement blocks thoroughly matured, or by such other means as the Postmaster-General may approve before the cable is laid.

(2) Cables in subways or tunnels shall be supported in such a manner as to prevent fracture of the lead covering.

5.—(1) Distributing wires (that is wires from a distribution point to exchange subscribers' offices) may be carried either overhead or underground, as may be considered desirable, and overhead distributing wires may either be open or be contained in a cable.

(2) No overhead wire extending more than a quarter of a mile from a distribution point shall be considered to be a distributing wire.

(3) Wires other than distributing wires may be carried overhead—

(*a*) Either open or in lead-covered cables. Provided that on one line of poles or other supports not more than 104 wires in all may be carried, of which only 64 may be open.

(*b*) In cables of any kind across a river, canal, estuary, or railway, or across overhead electric wires used for the purpose of lighting, traction or the transmission of power.

(4) Wires other than distributing wires may be carried overhead, either open or in cables without reference to the limitation contained in the last preceding sub-clause—

(*a*) In connection with any exchange system, or part of an exchange system which at the date of this agreement consists substantially of overhead lines (a list of which exchange systems and parts of exchange systems has been furnished by the company to the Postmaster-General, and is identified by the signatures of the secretary to the Post Office and of the general manager of the company). Provided that—

(i) In no case shall more than 104 circuits, or 208 wires, be carried in cables on any one line of poles, or other supports to be hereafter erected, or more than 104 circuits or 208 wires be hereafter added in cables to any one line of poles or other supports now existing; and

(ii) All cables hereafter erected shall be lead-covered when practicable; and

(iii) The case of each exchange system, or part of an exchange system which is specified in the aforesaid list, and which is established in a town having a population of 50,000 inhabitants and upwards according to the last census, shall, if the company so request, be specially considered and in respect of each such exchange system or part of an exchange system the Postmaster-General shall notify the company within six calendar months from the date of the company's request, whether he is prepared to provide from time to time such underground works as the company may require for extending or adding to such exchange system, or part of an exchange system, on a systematic plan, and in default of his giving to the company an assurance to provide such works, the first preceding proviso to this sub-clause shall not apply in the case of such exchange system, or part of an exchange system.

(*b*) In cases where the company are unable to execute underground works by virtue of any powers which they may possess, or are unwilling to execute such works in consequence of the terms and conditions proposed by a local authority, and the Postmaster-General (whether the company possess such powers as last aforesaid or not), after application to him by the company in that behalf, refuses or fails to agree within a reasonable time to provide the underground works specified in the company's application.

(5) Except, as aforesaid, no wires of any kind shall without the consent in writing of the Postmaster-General be carried overhead.

6. All instruments, wires, and apparatus shall be such that the transmission of speech thereby shall not be inferior in audibility to that afforded by test instruments connected by a length of test cable in accordance with the following regulations:—

(1) When—

(*a*) Any two exchange subscribers' circuits are connected together on the same exchange, or

(*b*) The circuit of an exchange subscriber whose office is on one exchange in an exchange area, is connected with the circuit of another exchange subscriber whose office is on a different exchange in the same exchange area, and the radial distance between the two exchanges does not exceed 10 miles,

the standard of speech shall not be inferior to that afforded by test instruments connected by a length of 20 miles of test cable:

Provided that where an exchange subscriber's office situate more than five miles from an exchange, is connected with another exchange subscriber's office situate more than five miles from another exchange, the standard of speech between such offices shall be deemed satisfactory if not inferior to that afforded by test instruments connected by a length of 25 miles of test cable.

(2) When the circuit of an exchange subscriber whose office is on one exchange in an exchange area is connected with the circuit of another exchange subscriber whose office is on a different exchange in the same exchange area and the radial distance between the two exchanges exceeds 10 miles but does not exceed 50 miles, the standard of speech shall not be inferior to that afforded by test instruments connected by a length of 30 miles of test cable.

Provided that where an exchange subscriber's office situate more than five miles from an exchange is connected with another exchange subscriber's office situate more than five miles from another exchange, the standard of speech between such offices shall be deemed satisfactory, if not inferior, to that afforded by test instruments connected by a length of 35 miles of test cable.

(3) When the circuit of any exchange subscriber is connected to a prescribed post office in the same exchange area, for the purpose of being connected to a trunk wire of the Postmaster-General, the standard of speech through the exchange subscriber's circuit and the junction circuit or circuits combined (exclusive of the trunk wire) shall not be inferior to that afforded by test instruments connected by a length of five miles of test cable.

Provided that where the radial distance between a prescribed post office and an exchange, when added to the radial distance between an exchange subscribers' office and the same exchange exceeds nine miles, the standard of speech through the exchange, subscribers' circuit and the junction circuit or circuits combined (exclusive of the trunk wire) shall be deemed satisfactory, if not inferior, to that afforded by test instruments connected by a length of eight miles of test cable.

7. All new and reconstructed exchanges shall be provided with automatic calling and clearing apparatus on every exchange subscriber's circuit, and the calling and clearing signals shall be effective in all conditions and upon the longest circuits used in an exchange area when connected together.

Provided that automatic calling and clearing apparatus need not be provided in any new or reconstructed exchange designed for an ultimate maximum capacity of not exceeding 1,000 direct subscribers' lines, and a fitted capacity of not exceeding 400 such lines, if in any such case a thoroughly efficient method of calling the exchange and signalling the close of a conversation is provided.

8. In exchange equipments on the multiple system, the multiple jacks shall be connected on the branching system, except in cases in which not more than 10 jacks are in series.

9. Junction circuits connecting exchanges with prescribed post offices shall be provided with automatic signalling arrangements of a character approved by the Postmaster-General and suitable for working in connection with his trunk lines, and shall be worked in accordance with such regulations as he may from time to time prescribe.

10. The apparatus fitted at exchange subscribers' offices shall be efficient for trunk line communication, and where separate batteries are provided at each exchange subscriber's office for speaking purposes, the electromotive force shall not at any time fall below two volts, and such apparatus shall be so fitted as to admit of a clearing signal being transmitted by the exchange subscriber to the prescribed post office to indicate the close of a trunk conversation.

11. With a view to avoid difficulty under the last two preceding clauses, the company shall at least six calendar months before the bringing into use of a new exchange equipment in an exchange, furnish the Postmaster-General with diagrams illustrating both the exchange subscribers' circuits and the method by which it is proposed to actuate the signals on the junction circuits at the prescribed post office.

12. Where an overhead electric system used for the purpose of lighting, traction or the transmission of power is worked in the neighbourhood of any overhead circuits of the company, suitable safety devices, including fuses and heat coils, shall in all circuits likely to be affected be provided both at the exchange and at the exchange subscribers' offices.

13. Efficient lightning protectors shall be provided on all circuits.

14.—(1) Proposals for the modification of the foregoing specification and rules, either generally or in relation to any particular case, will be considered by the Postmaster-General or the company (as the case may be).

(2) The fact that overhead work is for some purposes authorised by the specification and rules contained in this schedule, is not to prejudice the right of the Postmaster-General to raise any question with regard to the value of overhead work which he is authorised to raise under Clause 4 of this agreement.

(3) The specification and rules contained in this schedule do not apply to the internal exchange plant of the company specified in the list to be furnished by the company to the Postmaster-General under Clause 3 of this agreement.

(4) Notwithstanding anything contained in the specification and rules contained in this schedule the existing internal exchange plant of the company may be utilised to the extent of the capacity for which it has been designed, but such internal exchange plant may not be extended beyond the capacity for which it has been designed otherwise than in conformity with the said specification and rules, provided that, if any question arises between the Postmaster-General and the company as to the capacity of any

internal exchange plant, the question shall be determined by arbitration.

The Fourth Schedule sets forth the maximum and minimum charges for use of the exchange systems of the company other than the London exchange system.

Service.	Maximum charge.	Minimum charge.
A.—For Exclusive Lines within One Mile of the Exchange—		
I.—Subscription, with unlimited number of messages.	£10 per annum.	£5 per annum.
II.—(1) Subscription, exclusive of the transmission of messages.	£5 per annum.	£2 per annum.
(2) For each message	2d.	½d.
For subscribers over one mile from the exchange—		
For every additional quarter of a mile, or a part thereof, an additional charge of.	25s. per annum.	Nil.
B.—For Party Lines.		
(a) Where the main circuit does not exceed one mile in length and the spur circuits do not respectively exceed 220 yds. in length—		
I.—Subscription with unlimited number of messages—		
(1) Where two exchange subscribers use the same party line.	£8 per annum (per exchange subscriber).	£3 per annum (per exchange subscriber).
(2) Where three or four exchange subscribers use the same party line.	£6 per annum (per exchange subscriber).	£2 10s. per annum (per exchange subscriber).
II.—(1) Subscription, exclusive of the transmission of messages—		
(a) Where two exchange subscribers use the same party line.	£3 per annum (per exchange subscriber).	Nil.
(b) Where three or four exchange subscribers use the same party line.	£2 10s. per annum (per exchange subscriber).	Nil.
(c) Where more than four exchange subscribers use the same party line.	£2 per annum (per exchange subscriber).	Nil.
(2) For the transmission of each message of a party line subscriber to any office on an exchange in the same exchange area.	2d.	½d.
(B)—(1) Where the main circuit exceeds one mile in length, in respect of every additional quarter of a mile or part thereof—for every exchange subscriber whose spur circuit issues from the main circuit at a point exceeding one mile from the exchange	15s. per annum	Nil.
(2) Where the spur circuit exceeds 220 yds. in length—in respect of every additional quarter of a mile or part thereof.	25s. per annum.	Nil.

Charges are also defined for extension lines and for call offices, the latter having a maximum of 3d. and a minimum of ½d. for calls in the same area.

NEW PATENTS APPLIED FOR.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

703A. "Improvements in apparatus for use in wireless telegraphy." H. Heinicke. (Date applied for under Patents Rule 9, January 13th, 1905.) February 16th.

2,888. "An improvement in electrical trolley heads with wire-finding apparatus attached." J. T. Cherry and E. H. Clive. February 13th.

2,890. "Improvements in apparatus for electrically-operating gas valves." H. Scott. February 13th.

2,895. "An improved electric lampholder with locking device to prevent the withdrawal of a lamp therefrom." H. Hirst and H. Bevis. February 13th.

2,908. "Improvements in and relating to telephone switchboard connections." R. McLean. February 13th.

2,918. "Improvements in and relating to dynamos and the like." C. A. Vandervell and W. H. W. Procter. February 13th.

2,919. "Improvements in and relating to devices for controlling electric currents." C. W. Atkinson. February 13th.

2,930. "Improvements in electric switches and resistances." E. Garside. February 13th.

2,934. "Improvements in temperature compensating device for thermo-electric measuring instruments." W. H. Bristol. February 13th. (Complete.)

2,939. "Improvements in electric incandescence lamp fittings." F. W. Suter. February 13th. (Complete.)

2,940. "Improvements in electric switches." D. G. Pinkney and H. M. Rootham. February 13th.

2,944. "Improvements in and relating to transformers." O. de Faria. February 13th. (Date applied for under Patents Act, 1901, February 20th, 1904, being date of application in France.) (Complete.)

2,960. "An electric light maximum-demand alarm relay." G. O. Wills. February 13th. (Complete.)

2,982. "Improvements in line selectors for telephones and like systems." P. Hardegan. February 13th. (Complete.)

2,995. "An improvement in electrically heated curling tongs." J. McLean. February 14th.

2,998. "Improved ironing machine with electrically controlled pressure." A. E. Hacking and J. P. Croft. February 14th.

3,009. "Improvements in electrical tramway conduit systems." A. L. C. Fell and J. H. Rider. February 14th.

3,029. "An improved electrical insulating material." J. D. F. Andrews. February 14th.

3,047. "Automatic electric early morning waiter." G. J. Gray. February 14th.

3,049. "Combined electric coupling and two-way plug." H. Stokes. February 14th.

3,076. "Improvements in electric signalling apparatus." Eversheds and Vignoles, Ltd., and S. Eversheds. February 14th.

3,079. "Improvements in lightning arresters." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) February 14th.

3,081. "Improvements in protective devices for electric circuits." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) February 14th.

3,088. "Improvements in combined switches and fuses." A. J. Fuller February 14th.

3,125. "Improvements in or relating to electric motor-starters." F. J. Jones. February 15th.

3,129. "An improved life-guard for electric tramway cars and similar vehicles." S. R. Cameron. February 15th.

3,135. "Improved carbon brush-holder." B. Zingelmann. February 15th.

3,137. "Improvements in the construction of dynamo-electric machines and electric motors." E. S. G. Rees. February 15th.

3,166. "An improved X-ray tube for use with alternate or unidirectional currents." February 15th.

3,171. "Improvements in and relating to electric motors and dynamo-electric machines." Vickers, Sons & Maxim, Ltd., and A. D. Williamson. February 15th.

3,177. "Improvements in or relating to the control of electric motors." W. Geipel and F. M. T. Lange. February 15th. (Complete.)

3,183. "Automatic regulating apparatus for electrical installations with variable current consumption worked by dynamos and accumulator batteries." E. Dick. February 15th. (Complete.)

3,184. "Improvements in installations for controlling electrically-propelled trains." Siemens Bros. & Co., Ltd., and C. F. Jenkin. February 15th. (Complete.)

3,187. "Improvements in or connected with starting and driving mechanism suitable for use with gas engines, electro-motors and other engines." C. Baxter and A. Eavold. February 15th.

3,189. "Improvements in and relating to dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) February 15th.

3,195. "Improvements in or relating to apparatus for controlling electric motors." J. M. Barr. (Date applied for under Patents Act, 1901, March 7th, 1904, being date of application in United States.) February 15th. (Complete.)

3,196. "Improvements in controllers for electric motors." T. S. Perkins. (Date applied for under Patents Act, 1901, March 7th, 1904, being date of application in United States.) February 15th. (Complete.)

3,250 "Improvements in and relating to electric arc lamps." H. Bruckmann. February 16th.

3,265. "Improvements in electrical switches." E. Tyer. February 16th.

3,280. "Devices for exerting an electro-magnetic influence upon the arcs of electric arc lamps." T. L. Carbone. February 16th. (Complete.)

3,283. "Improvements in electrical sound-producing apparatus." A. C. M. Legendre. February 16th. (Date applied for under Patents Act, 1901, September 24th, 1904, being date of application in France.) (Complete.)

3,289. "Improvements in electric heaters." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.)

3,291. "Improvements in electric control apparatus." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) February 16th.

3,293. "Improvements in electric traction on a shallow conduit system." S. G. Bennett. February 17th.

3,312. "Electric self-acting apparatus for tightening ropes and the like." H. O. Adam. February 17th. (Date applied for under Patents Act, 1901, February 18th, 1904, being date of application in Germany.) (Complete.)

3,313. "Improvements in or relating to wireless telegraphy receivers." F. P. Reid. February 17th.

3,327. "Improvements in electrolytic meters." G. Hookham and S. Holmwood Holden. February 17th.

3,346. "Method of, and apparatus for, electrically oxidising atmospheric nitrogen." H. H. Lake. (D. Helbig, Italy.) February 17th.

3,347. "Improvements in switch apparatus for coin-freed electricity meters." J. M. Tourtel. February 17th.

3,359. "Improvements in automatic electrical cut-outs." C. A. Vandervell and W. Hodgson. February 17th.

3,366. "Improvements in, and relating to, means for driving dynamos and the like." C. A. Vandervell and W. Hodgson. February 17th.

3,369. "Improvements relating to sight magnetic compasses." A. F. C. Bentley. February 17th.

3,371. "Improvements in mechanism for actuating electrical clocks." G. Schönberg. February 17th. (Complete.)

3,392. "Improvements connected with trolley wires of overhead electric tramway systems." G. J. Conaty and H. Hartley. February 18th.

3,394. "Improvements relating to electric ignition apparatus for internal combustion motors and for like purposes." T. Morris. February 18th.

3,399. "Improvements in overwind switches." J. G. Childs. February 18th.

3,401. "Improvements in and relating to resistances for electric current." R. Hopfelt. February 18th. (Complete.)

3,409. "Improvements in the arrangement of multiple switchboards for telephone exchanges." Siemens Bros. & Co., Ltd. (Siemens & Halske Akt.-Ges. Germany.) (Complete.)

3,431. "Improvements in and relating to electrolytic meters." C. W. Atkinson. February 18th.

3,432. "Improvements in electric machineries." The Company "Sachsenwerk Light-und Kraft Akt.-Ges." February 18th. (Date applied for under Patents Act, 1901, February 20th, 1904, being date of application in Germany.) (Complete.)

3,433. "Improvements in devices for exerting an electro-magnetic influence on the arcs of electric arc lamps." T. L. Carbone. February 18th. (Complete.)

3,439. "Improvements relating to electro-medical apparatus." J. P. Pullin. February 18th.

3,442. "Improvements in and relating to gloves for electric insulation purposes." K. Weilbier. February 18th. (Complete.)

3,155. "Improvements in dynamo-electric machines and motors." W. R. V Marshall. February 15th.